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**EASTERN--WESTERN
ARCTIC SEA ICE ANALYSIS**

1990

**PREPARED BY
NAVAL POLAR OCEANOGRAPHY CENTER
SILVER SPRING, MD**

**PREPARED UNDER AUTHORITY OF
CHIEF OF CENTER, NAVAL OCEANOGRAPHY COMMAND
NAVAL OCEANOGRAPHY CENTER, MS 39529-5000**

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FOREWORD

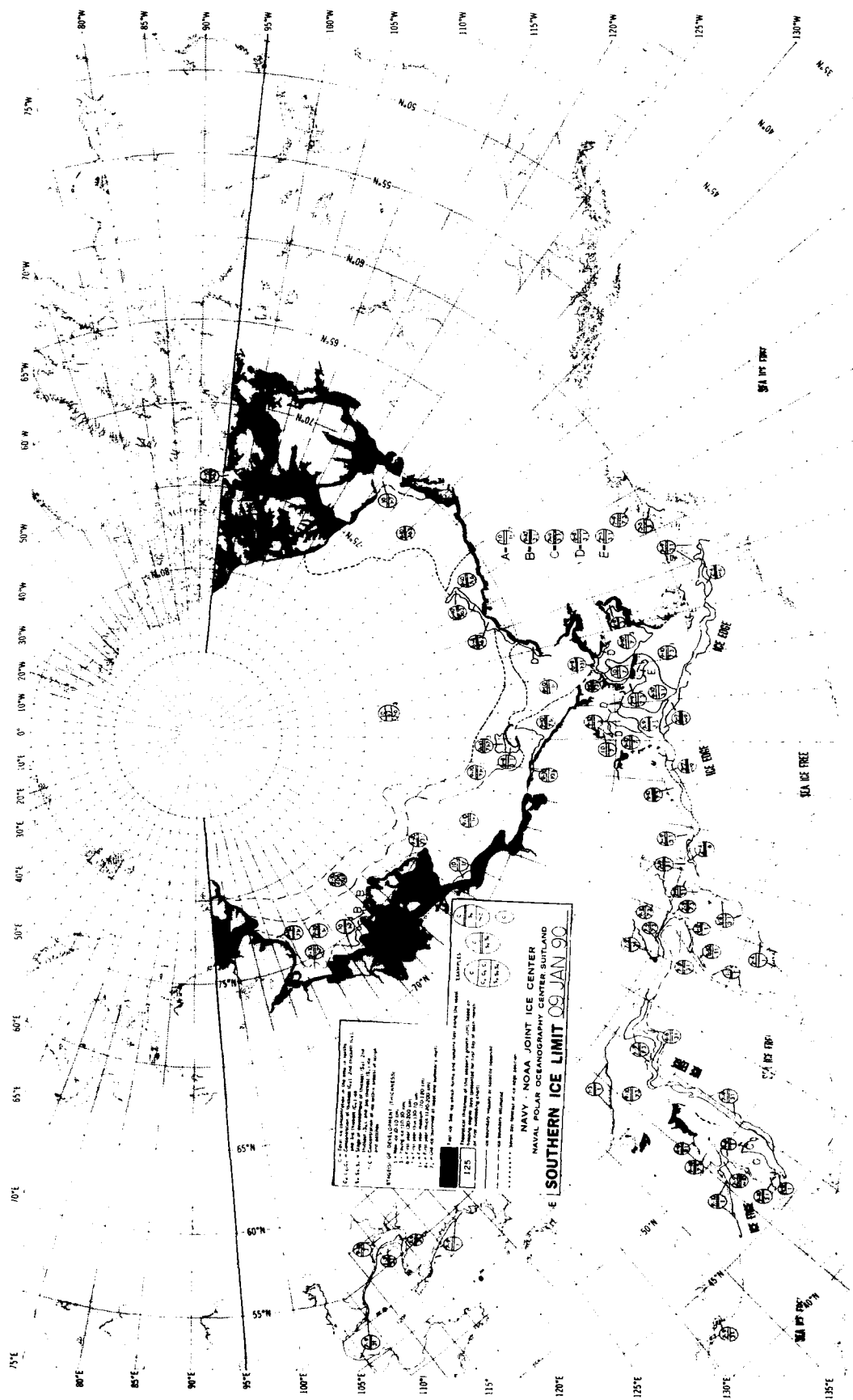
The U.S. Navy has a long and eventful history of polar exploration from Robert E. Peary in the Arctic to Richard E. Byrd in the Antarctic. In recent years the strategic importance and expanded research pursuits in these areas have resulted in greater national and international requirements for environmental information. Since 1976, the National Oceanic and Atmospheric Administration (NOAA) and the Navy have worked together at the Joint Ice Center (JIC) in Suitland, Maryland. By combining the Navy's experience in observing and recording sea ice data, and NOAA's expertise in satellite data collection and interpretation, the JIC has been able to keep pace with that demand in both polar regions.

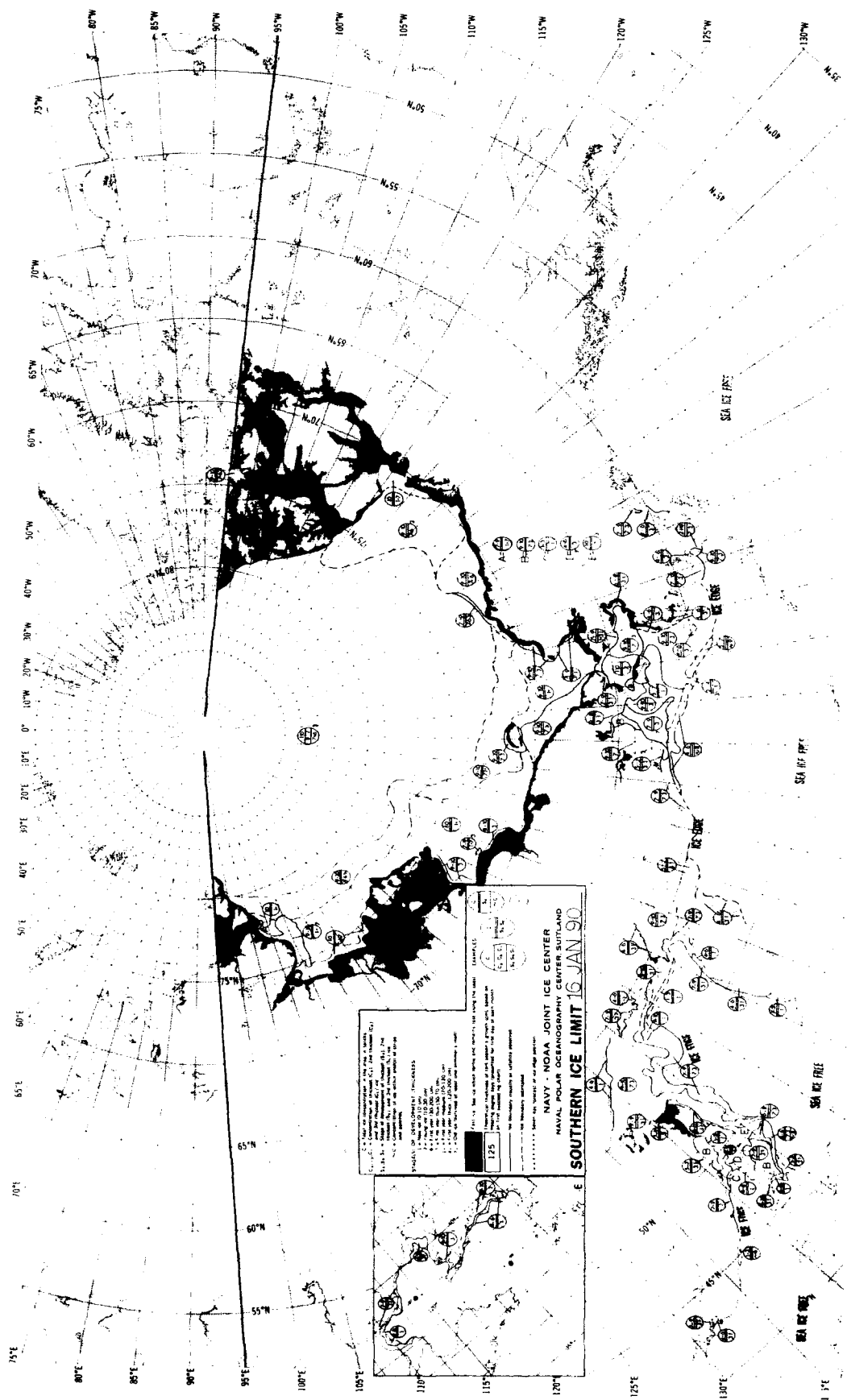
This publication is the 17th edition of the Arctic sea ice atlases prepared by the JIC. The atlas contains weekly charts depicting Northern Hemisphere and Great Lakes ice conditions and extent. The significant use of high resolution satellite imagery, combined with valuable ice reconnaissance data from various sources, has greatly improved the accuracy of these analyses.

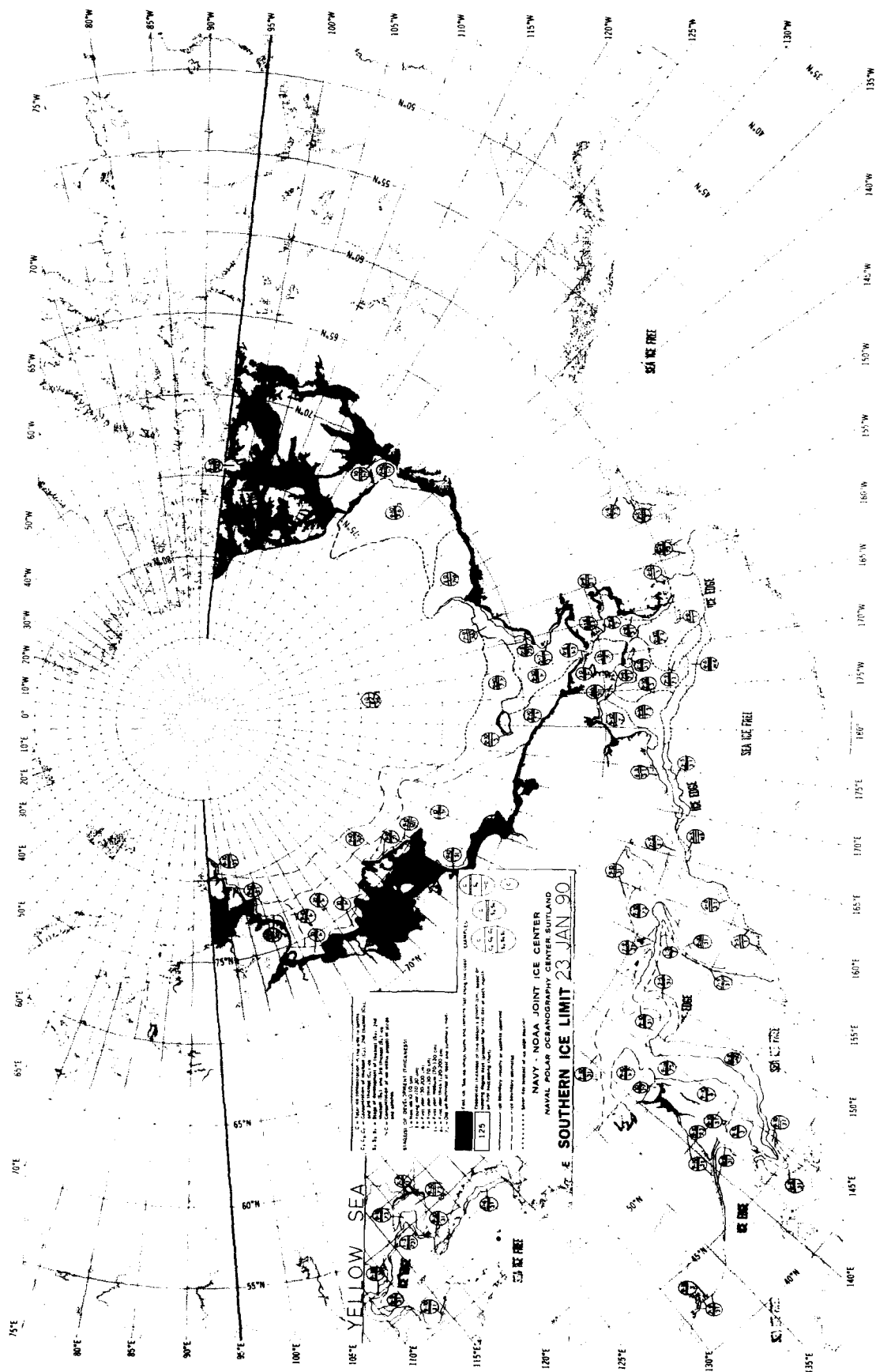
The purpose of this atlas is to provide the user with reliable weekly hemispheric ice analyses. Both Navy and NOAA personnel with considerable experience in sea ice analysis prepare the analyses. The following procedures have been developed to ensure the quality of the final products:

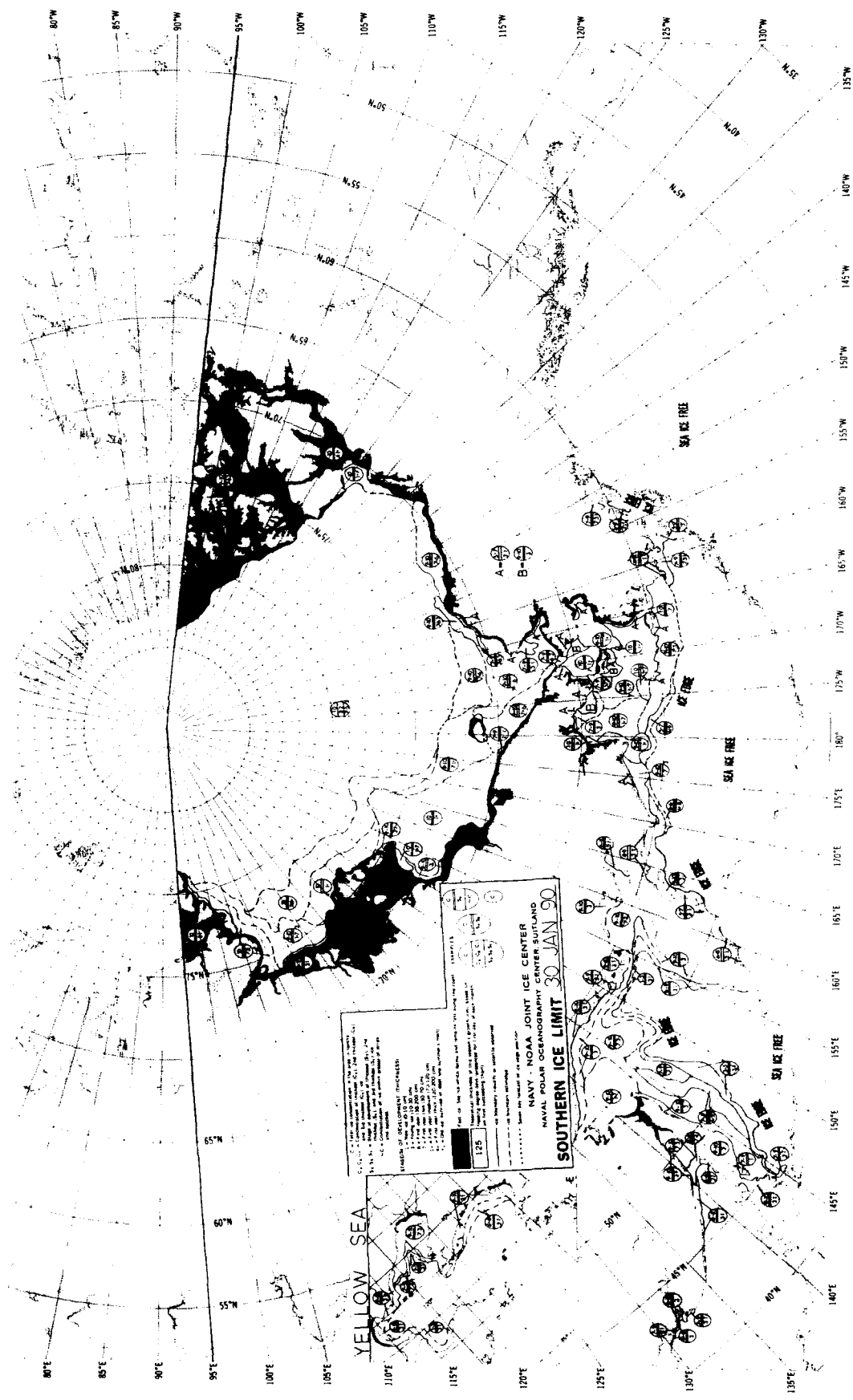
- a. Conventional shore station, ship and aerial ice reconnaissance observations are plotted and evaluated.
- b. Satellite data from different sensors is compared and analyzed for ice information content. Table I, located on the inside back cover, summarizes satellite data availability for 1990.
- c. A final product results from a. and b. However, where insufficient data is available, an estimated boundary will be depicted. Meteorological data and computer generated ice drift vectors are utilized to determine the estimated ice edge position.

NAVY / NOAA Joint Ice Center
Naval Polar Oceanography Center
4301 Suitland Road
Washington, DC 20395-5180







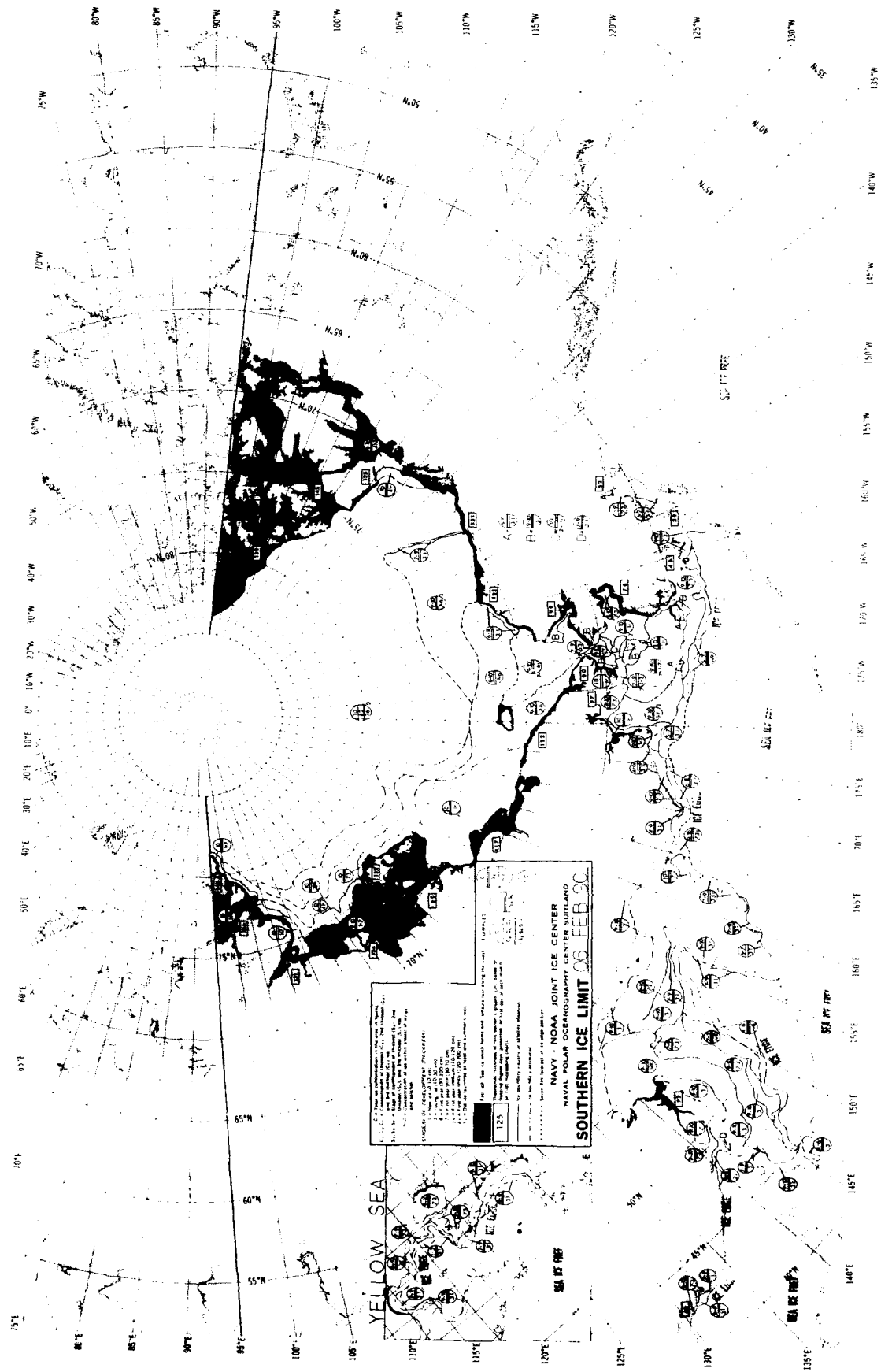


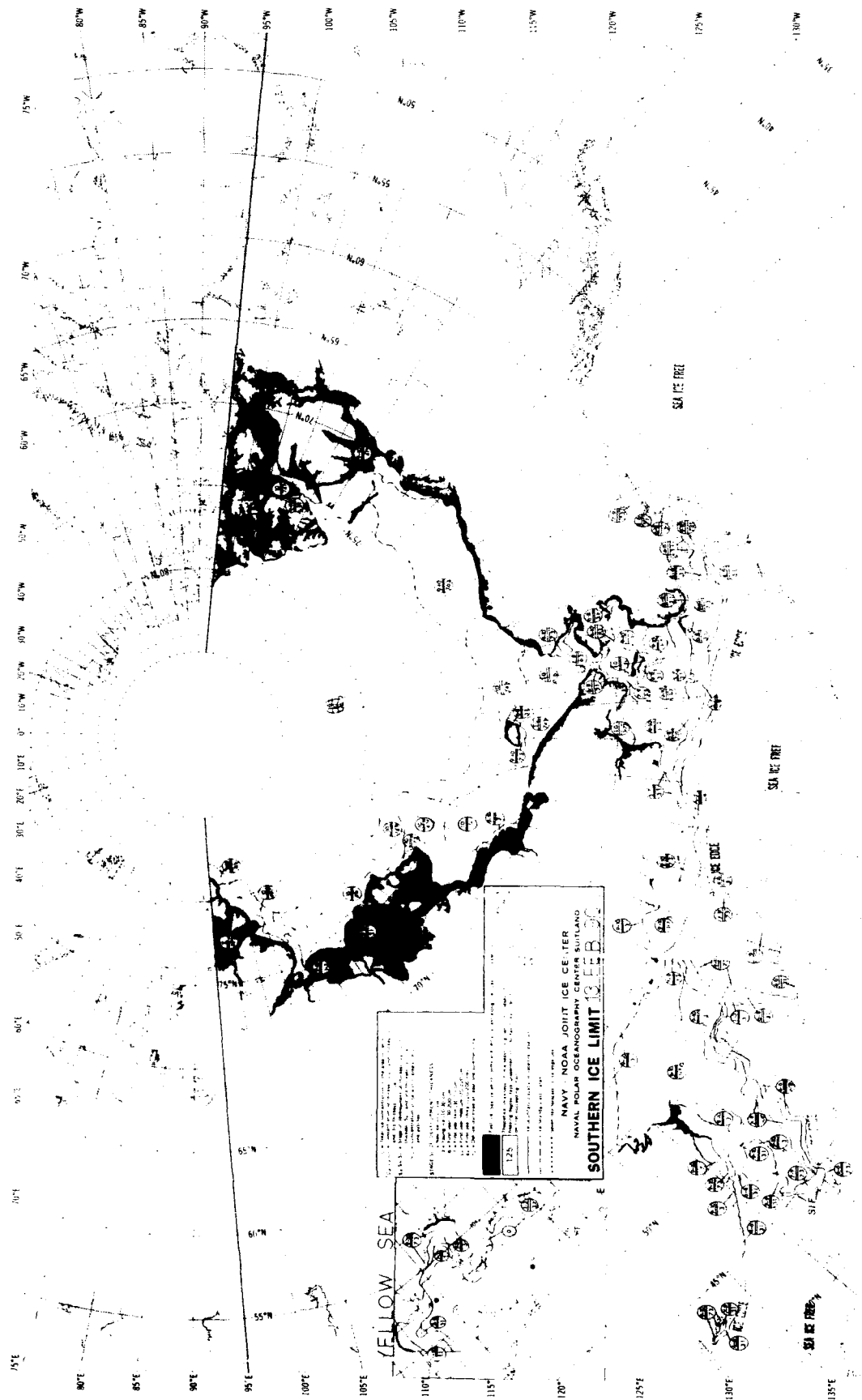
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NAVAL POLAR OCEANOGRAPHY CENTER SUTLAND
SOUTHERN ICE LIMIT 30 JAN 90

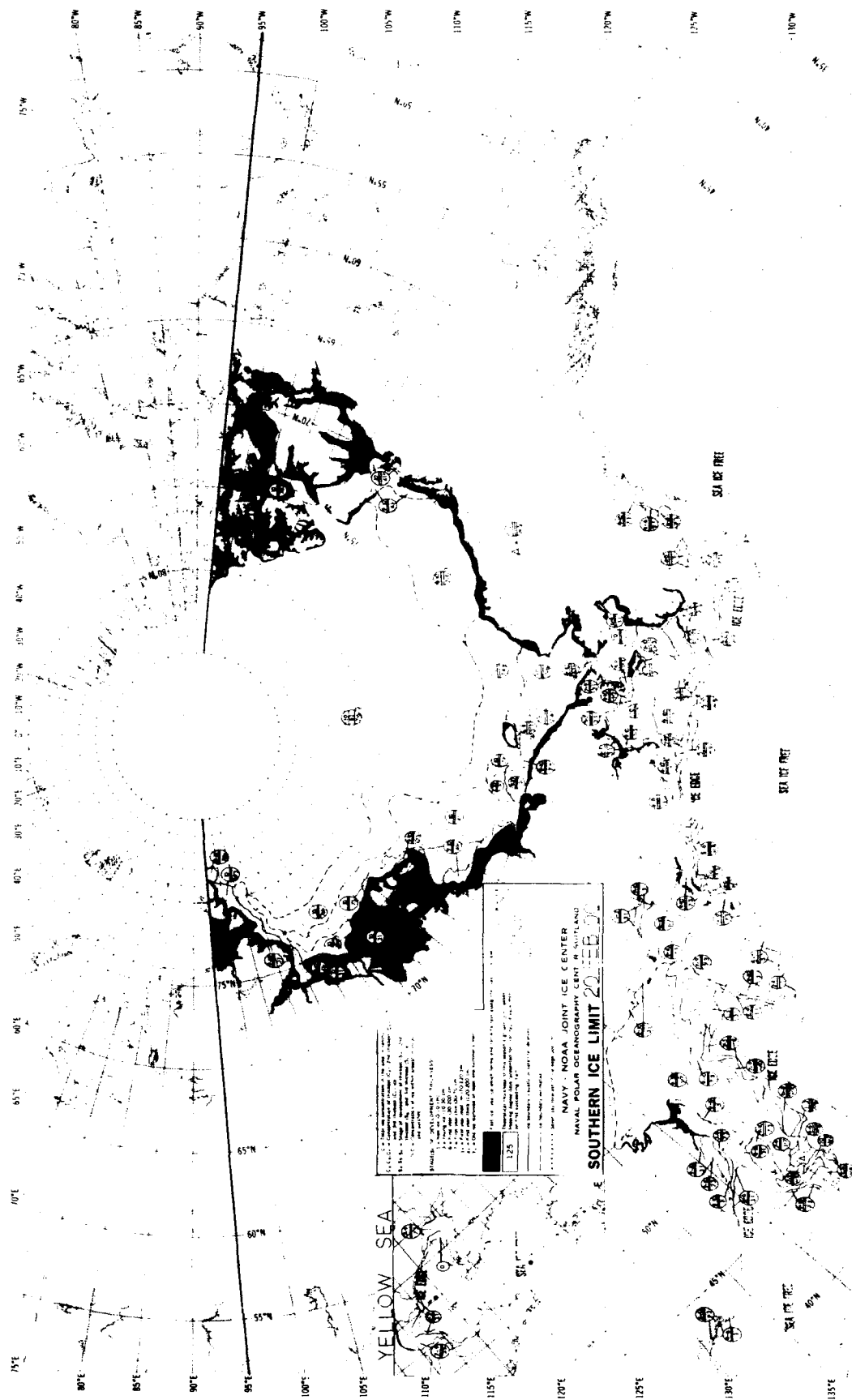
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NAVY - NOAA JOINT ICE CENTER
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SOUTHERN ICE LIMIT 30 JAN 90

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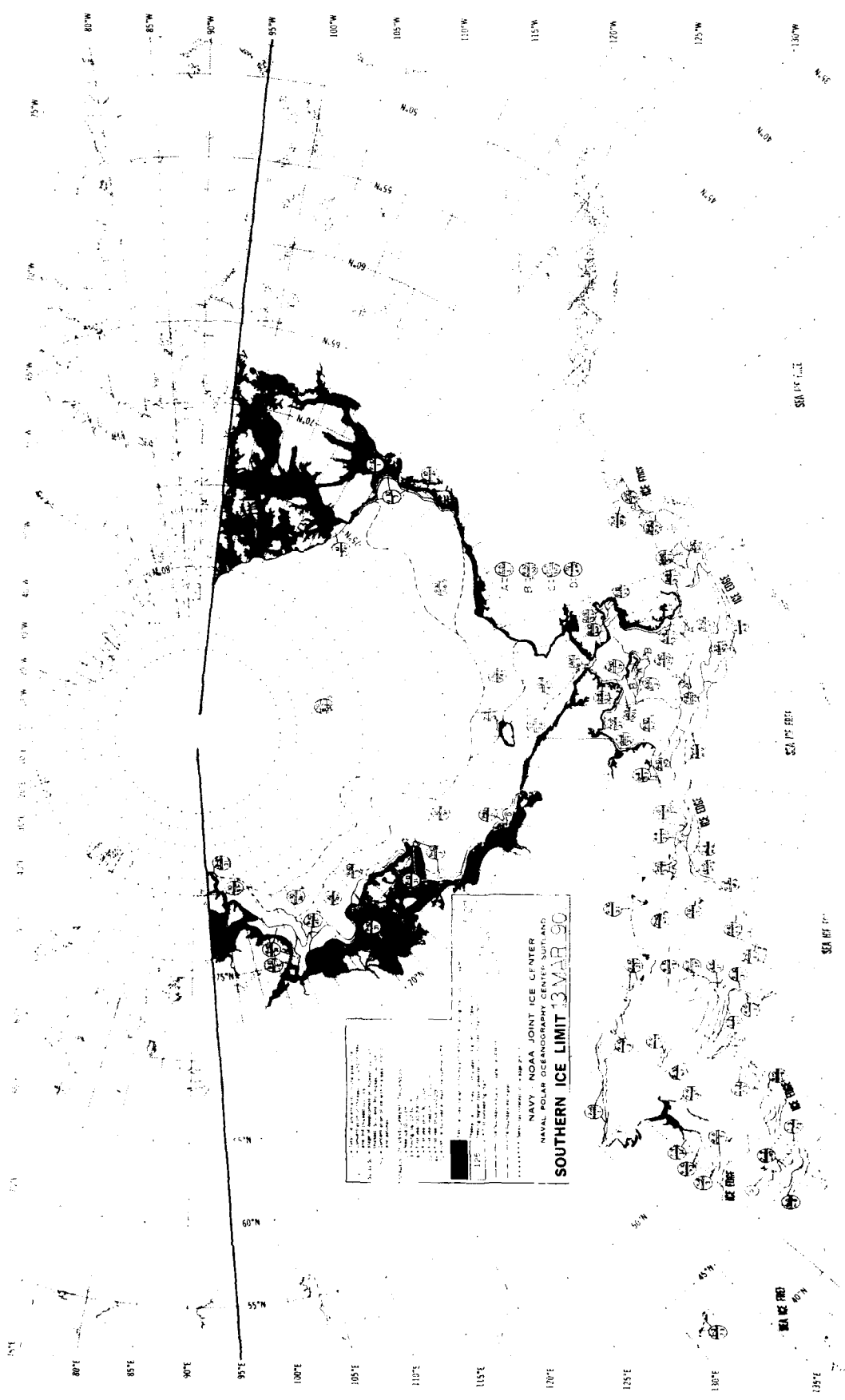




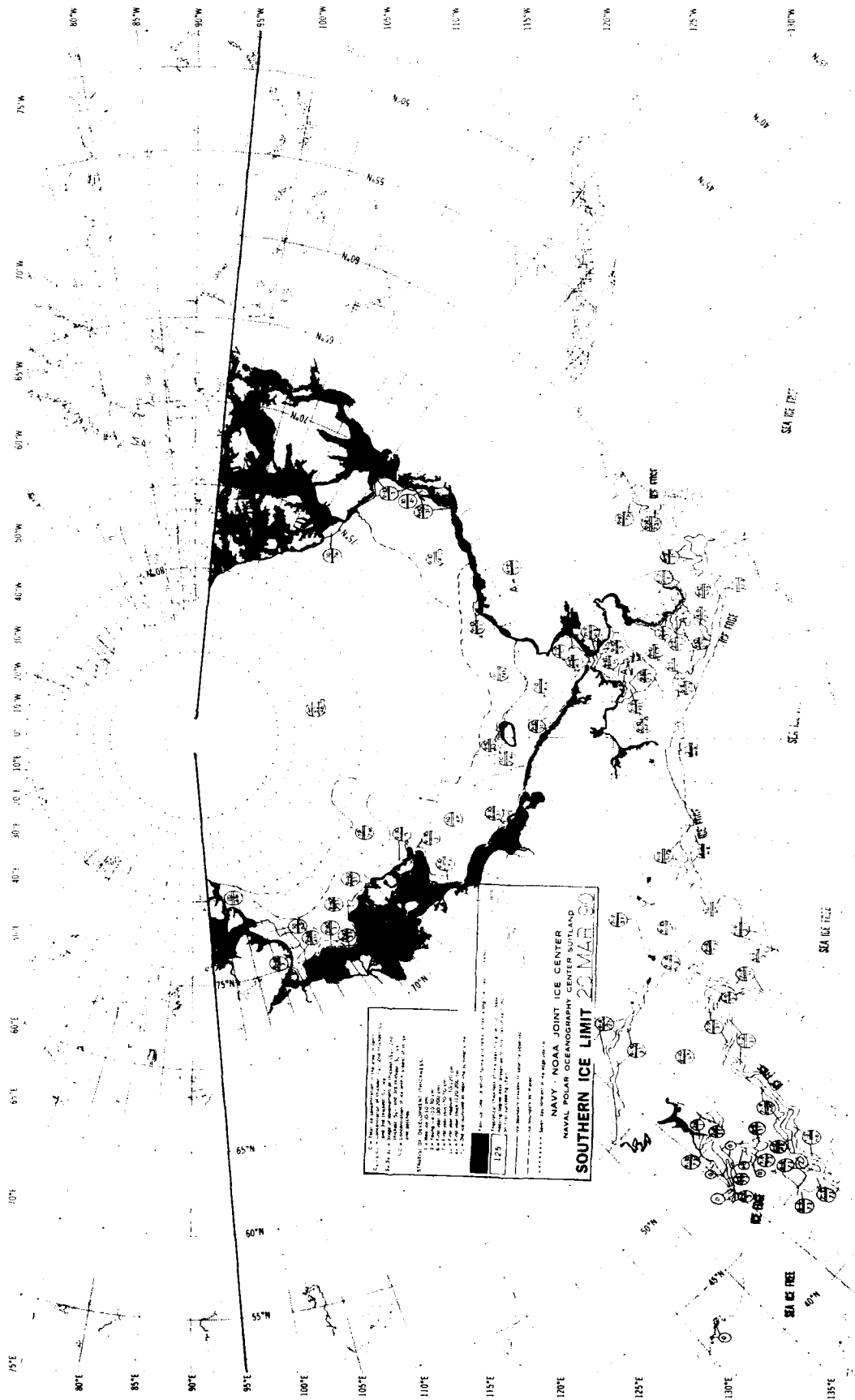


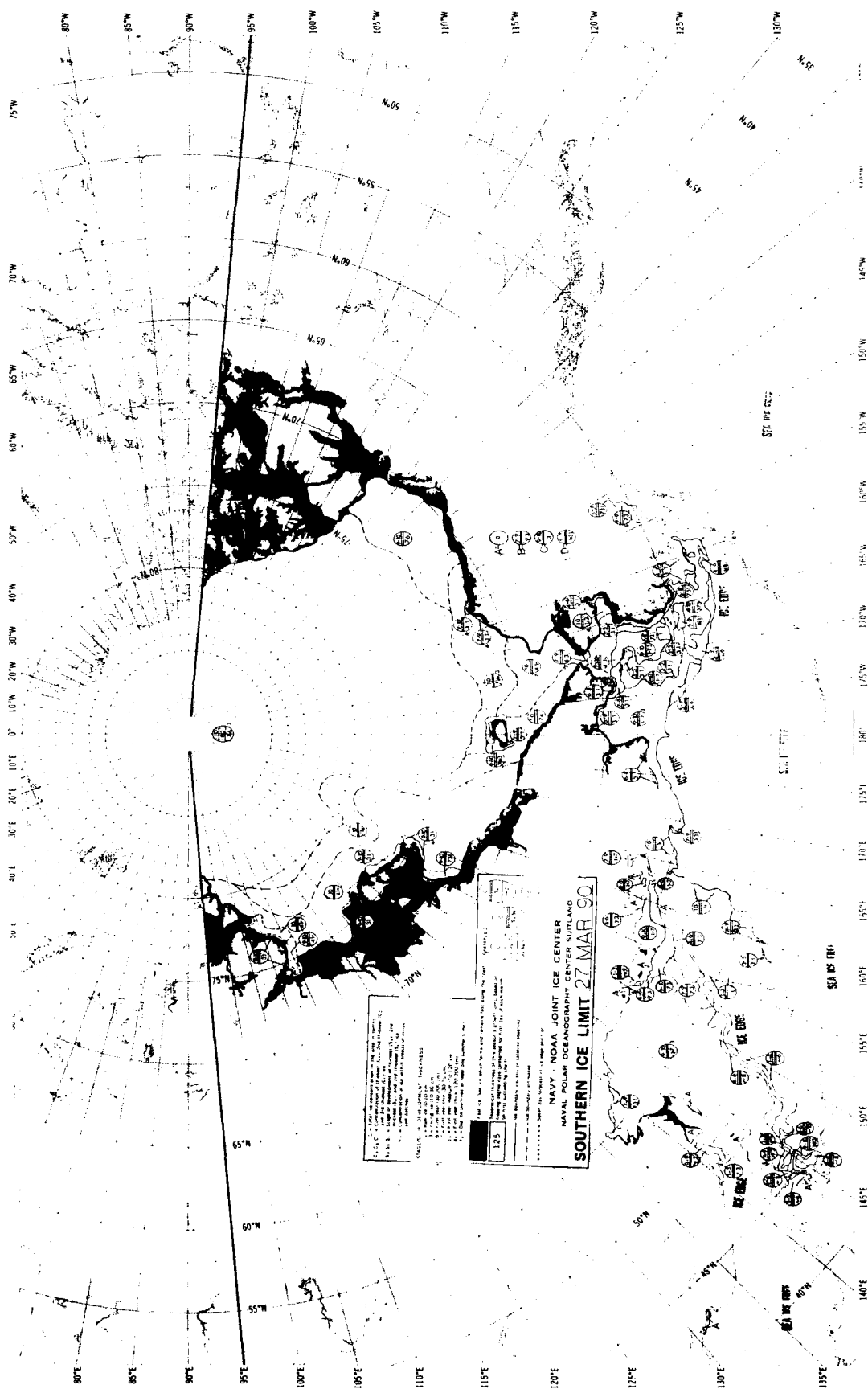


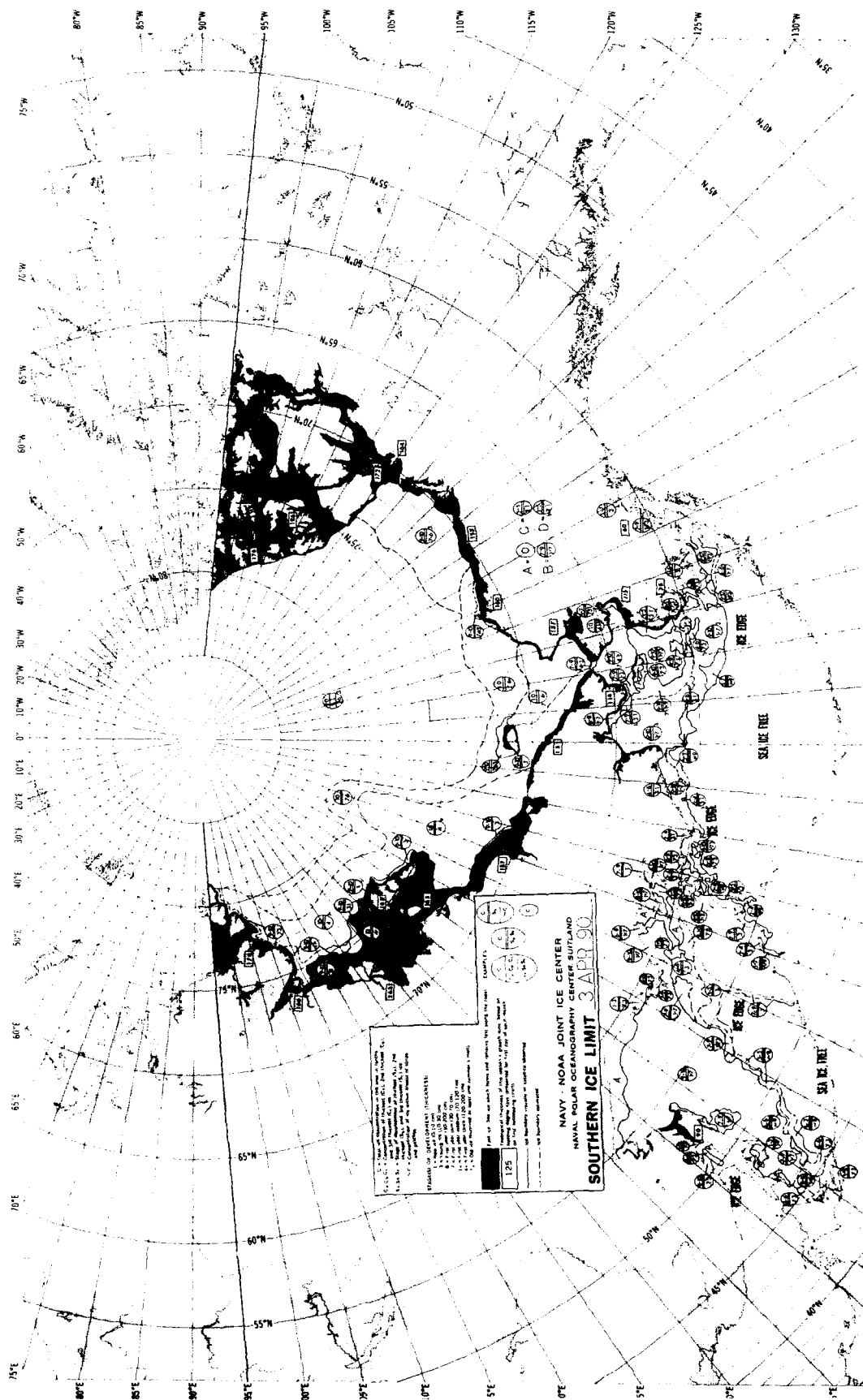


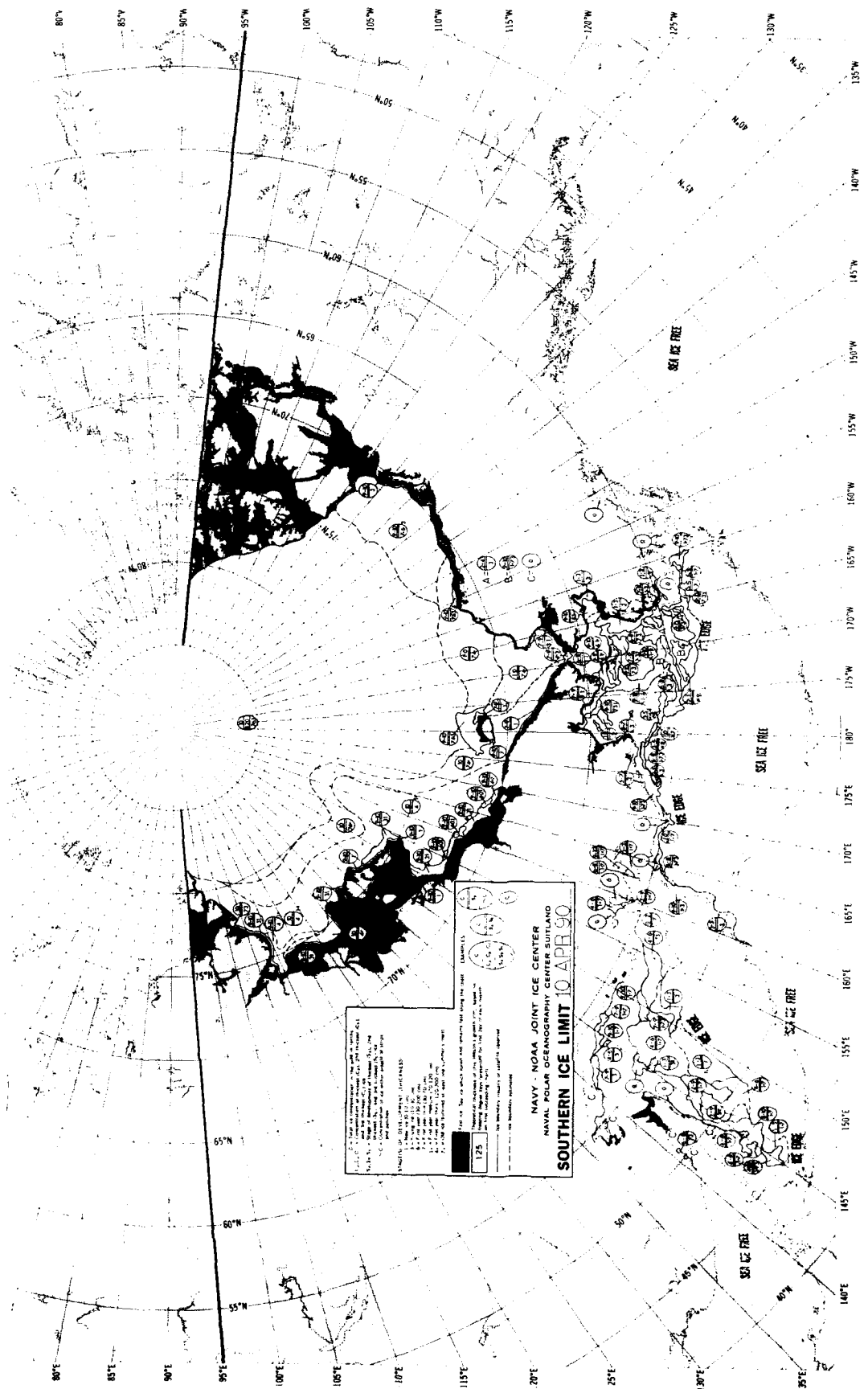


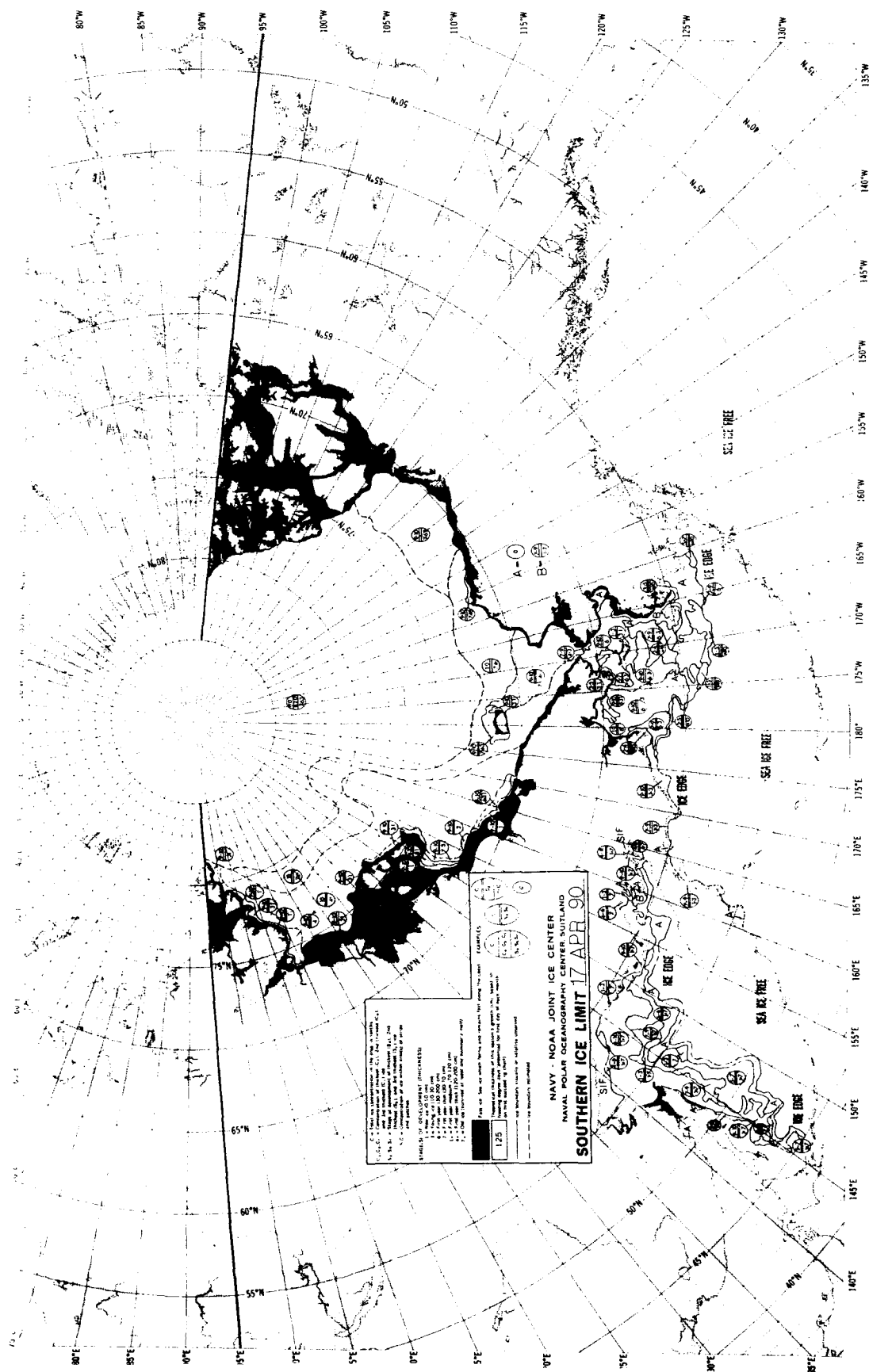
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NAVAL POLAR OCEANOGRAPHY CENTER SUITLAND
SOUTHERN ICE LIMIT 13 MAR 90

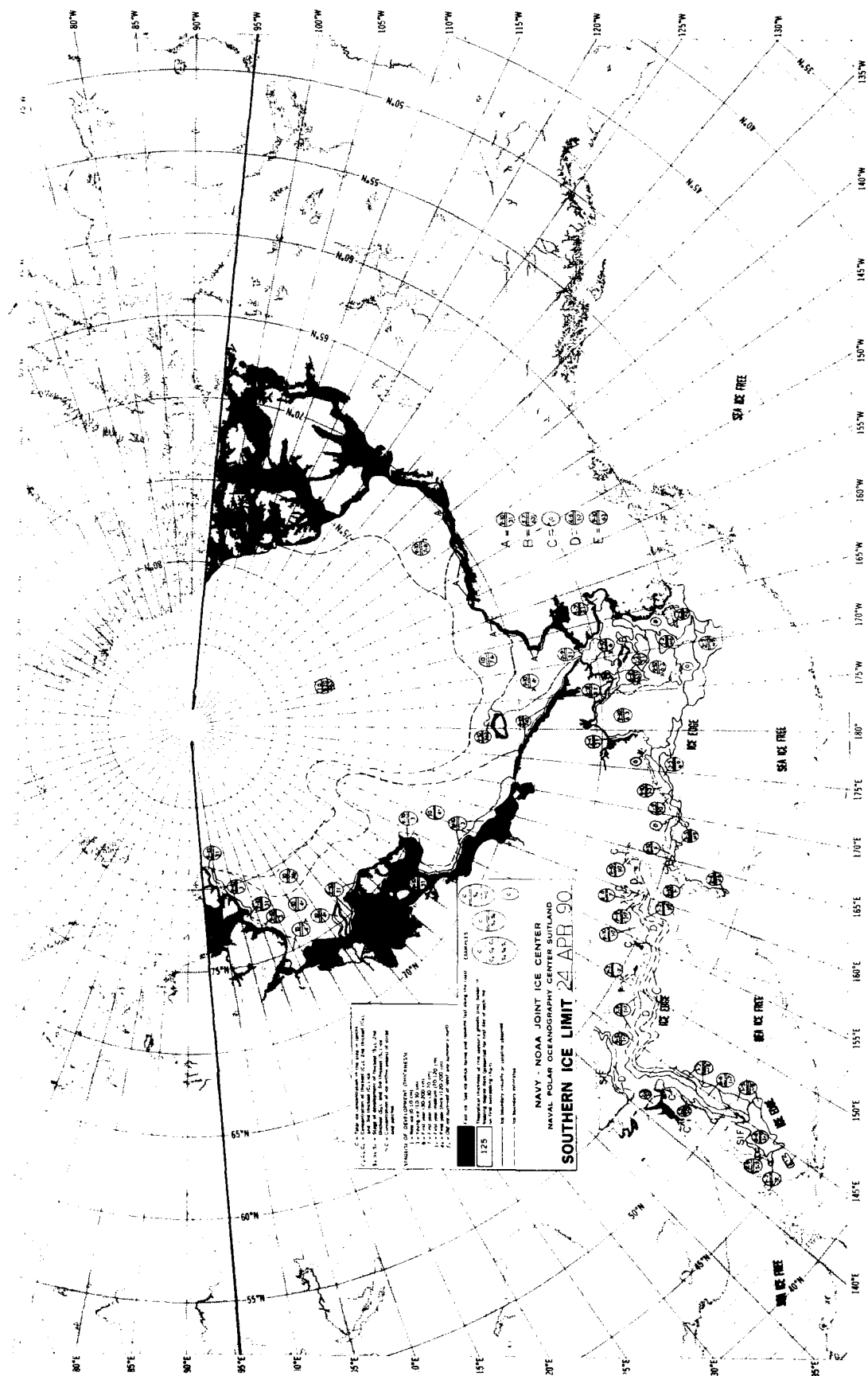


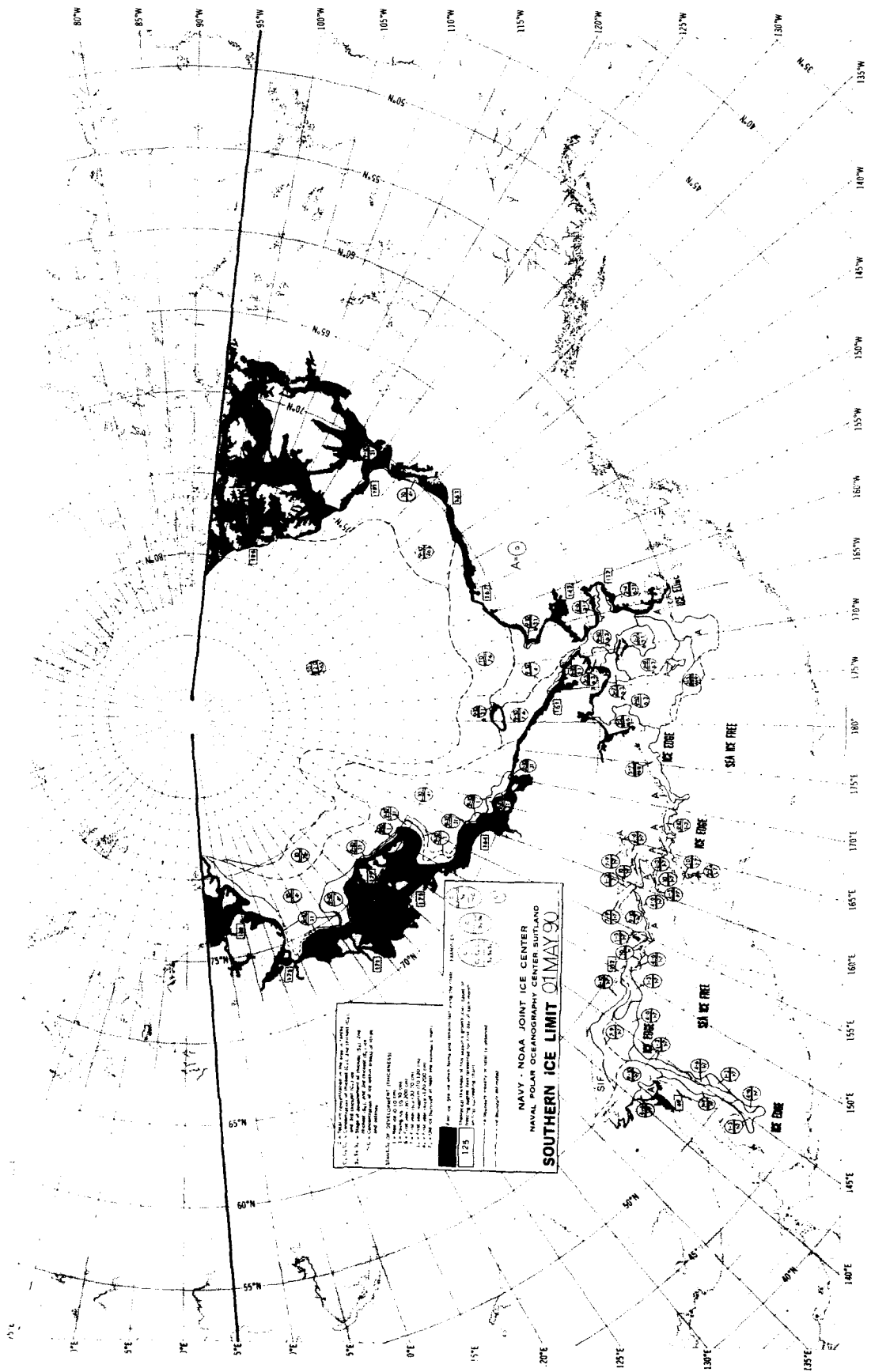


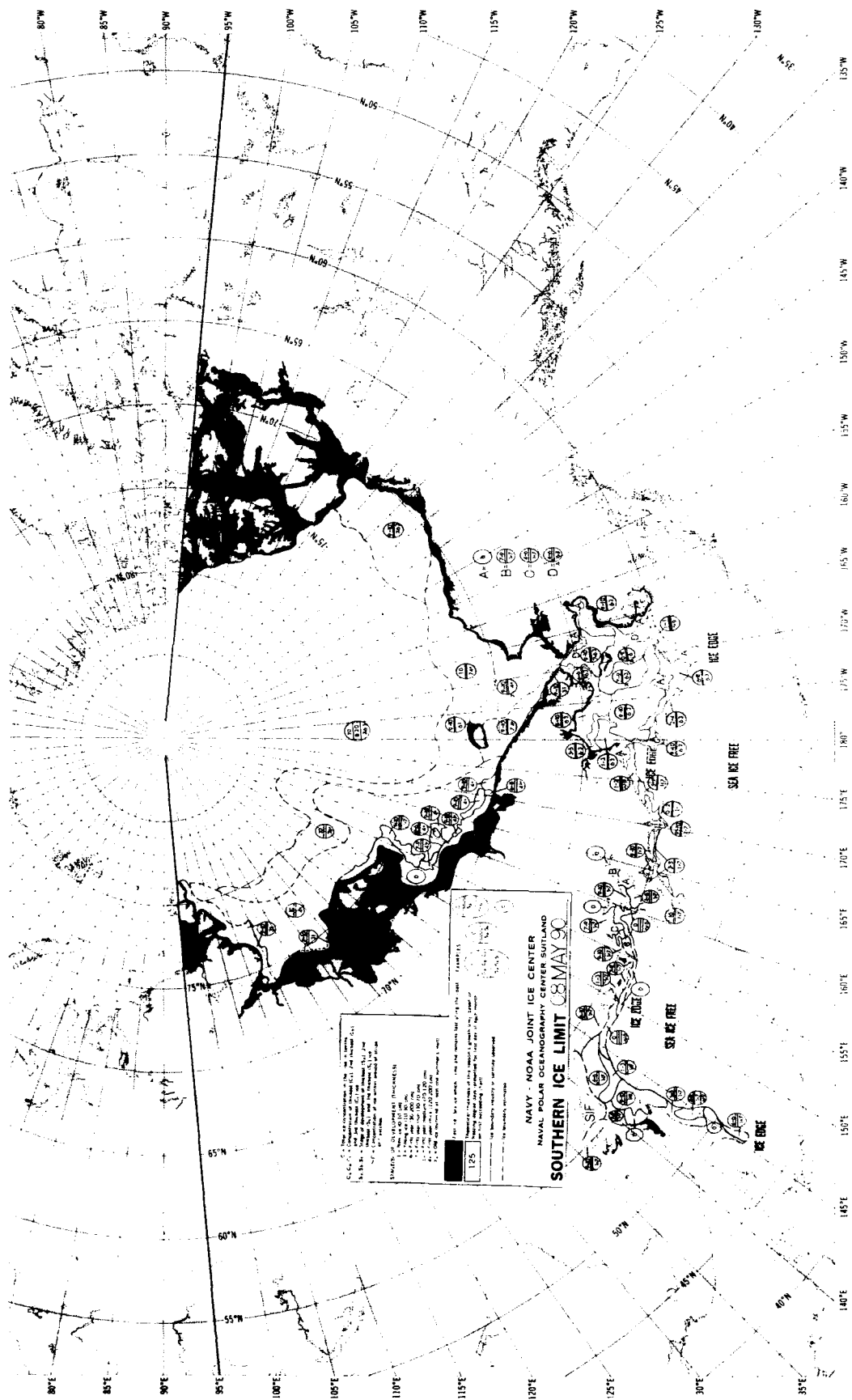


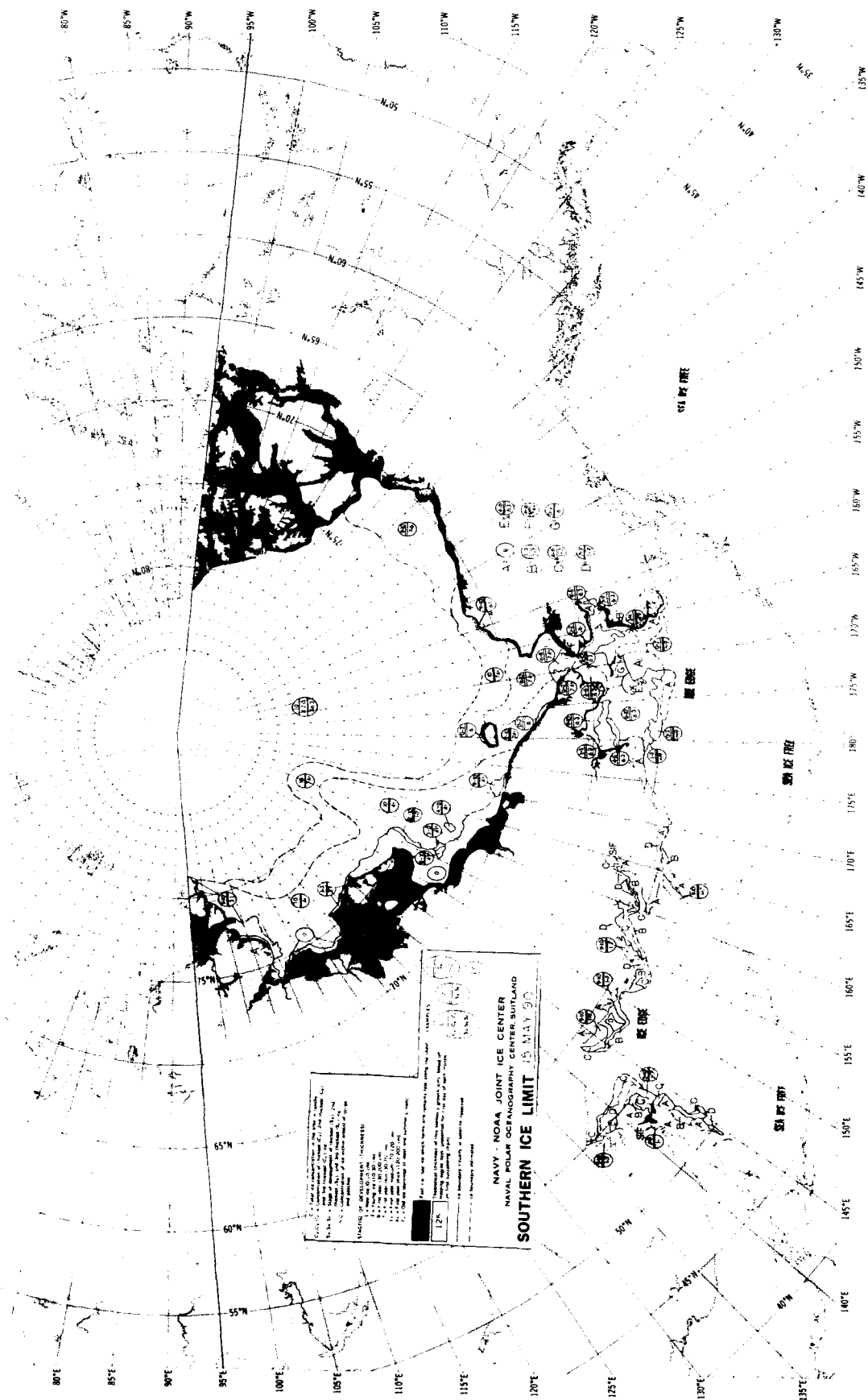


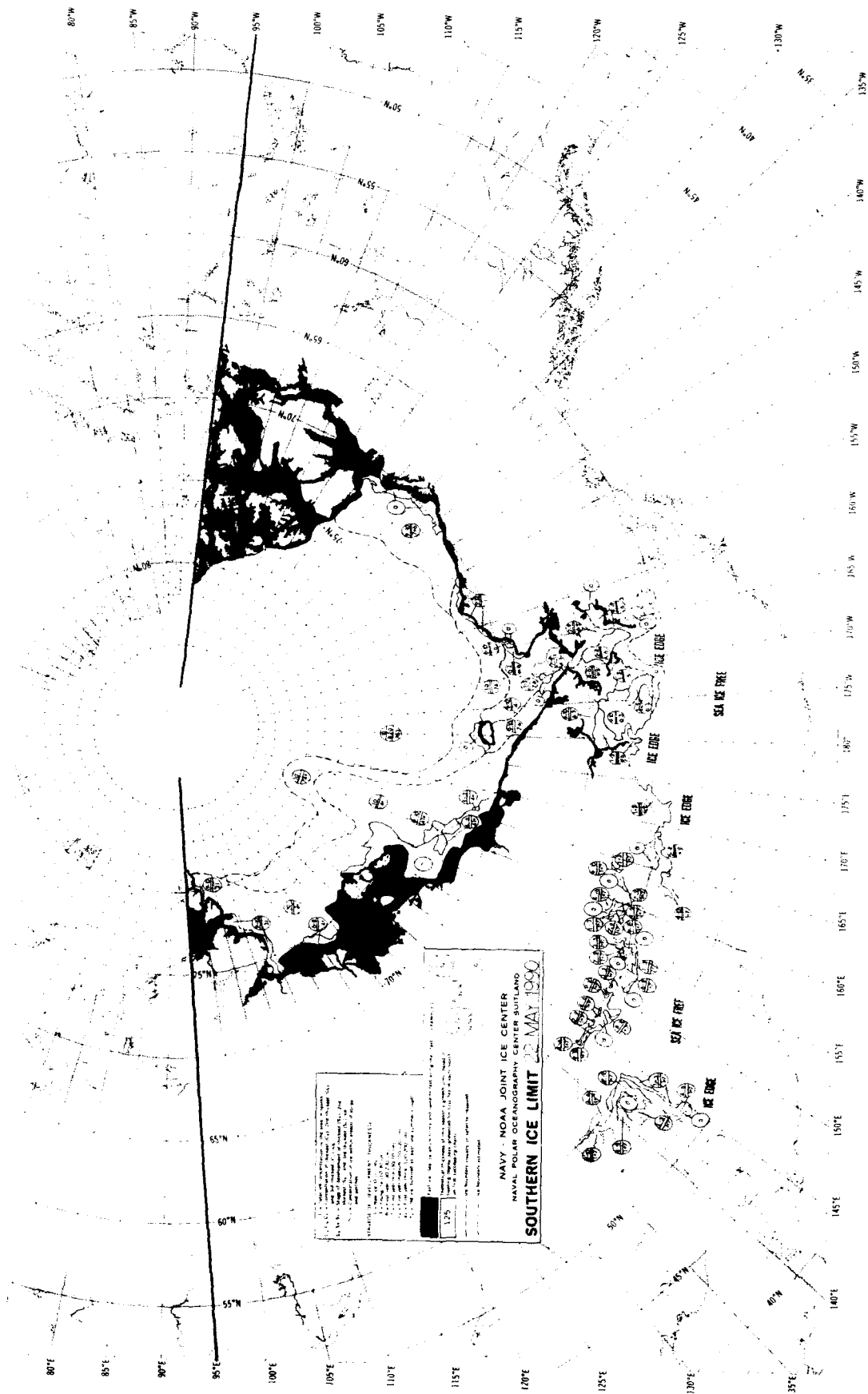


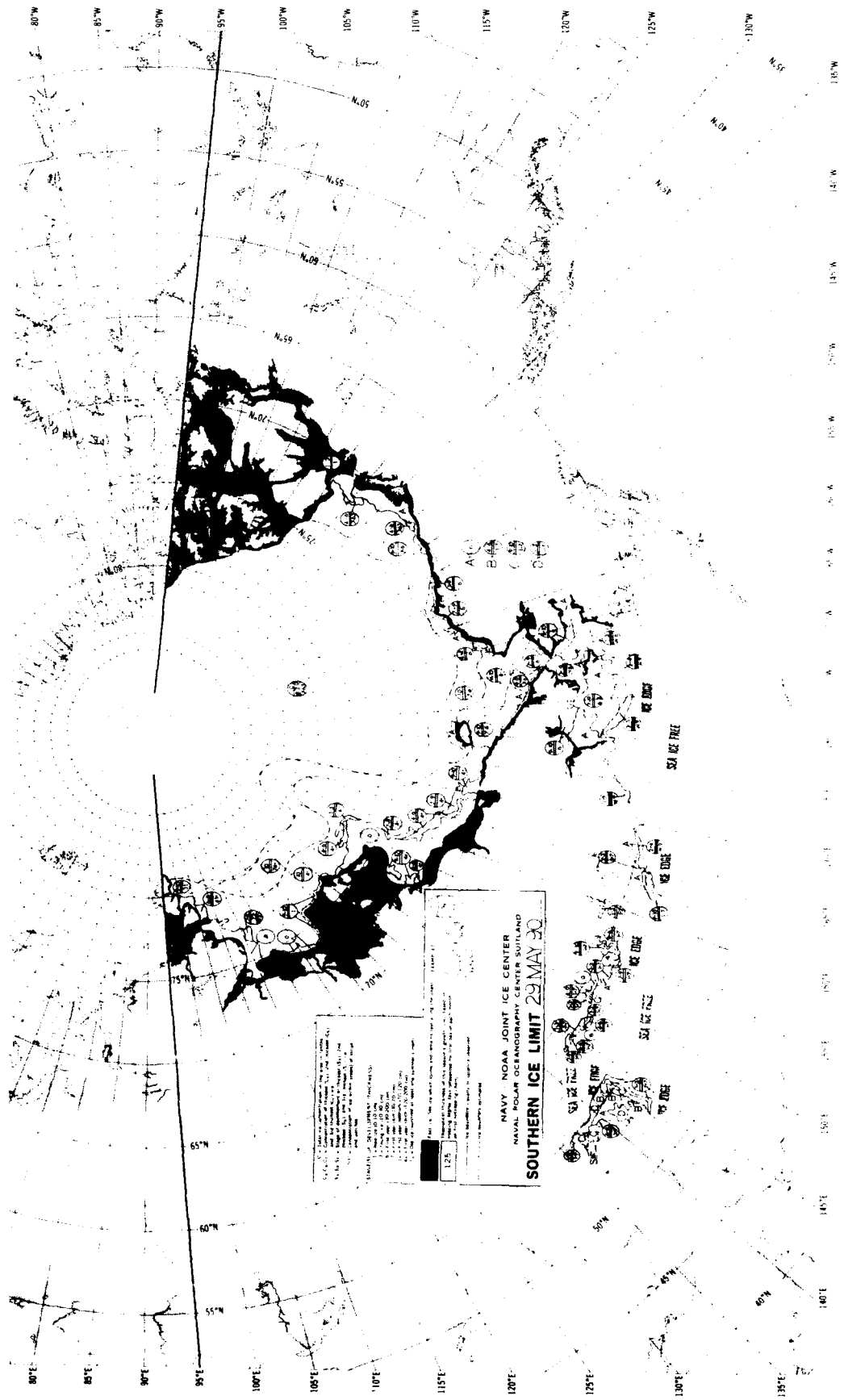






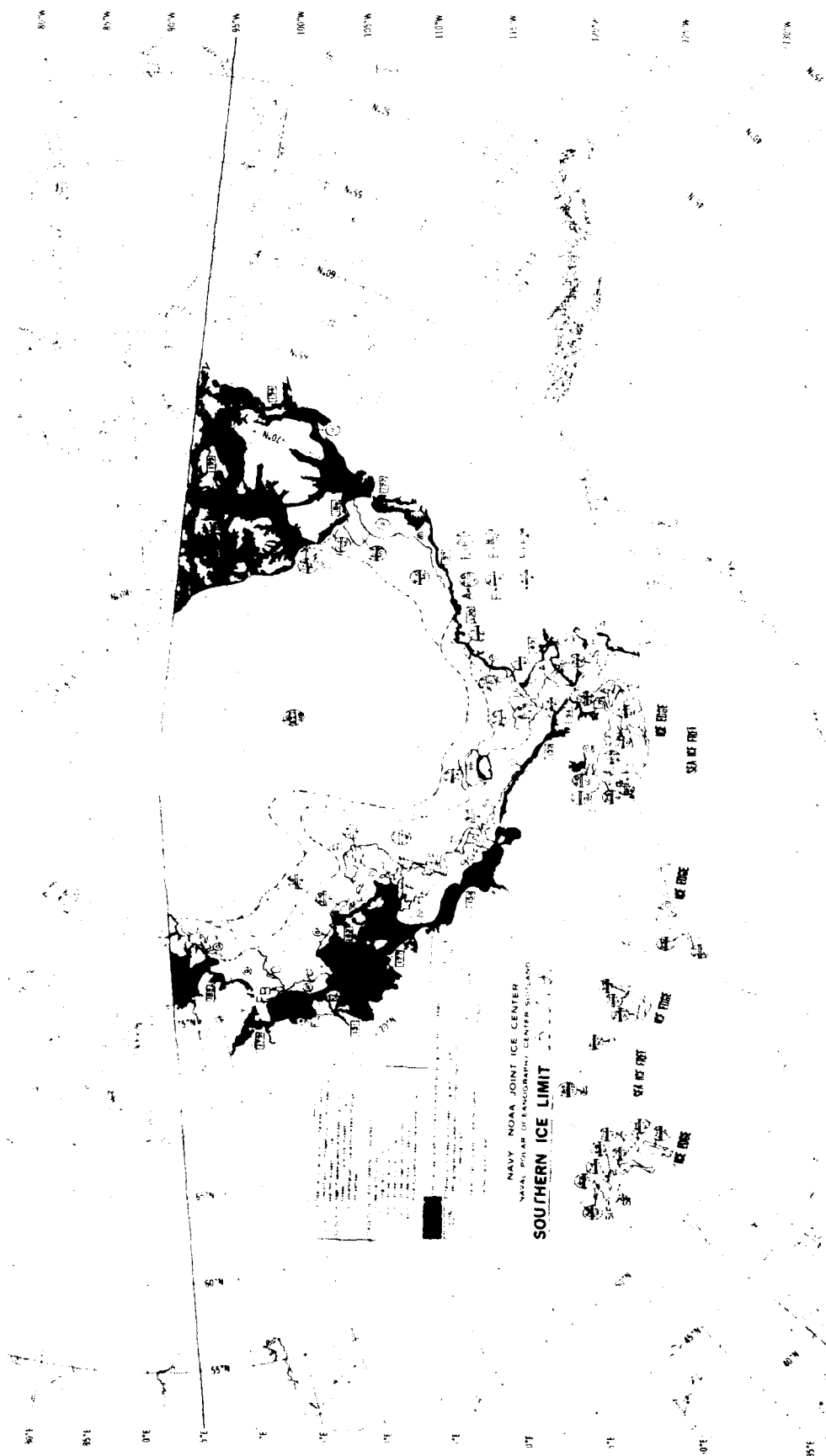


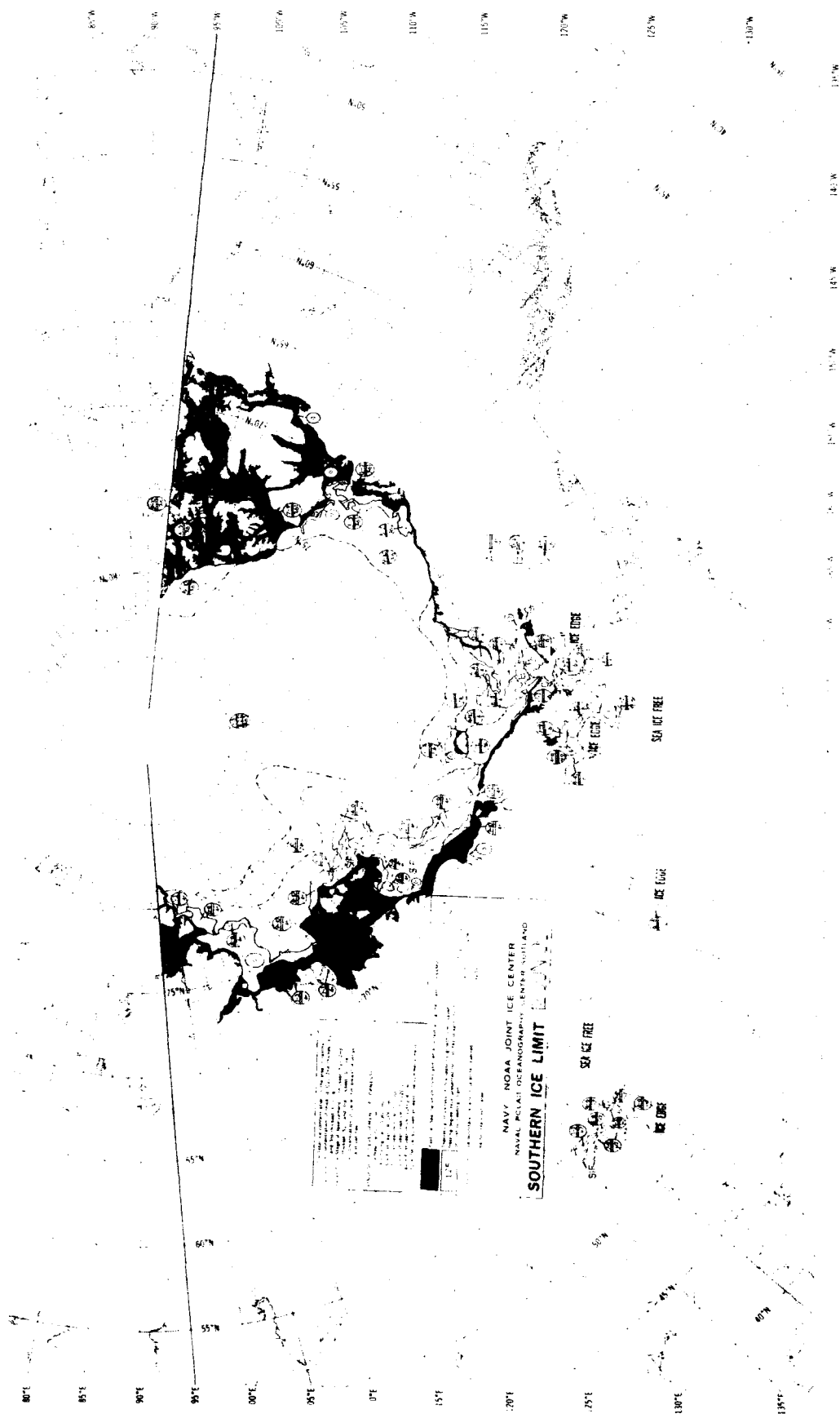


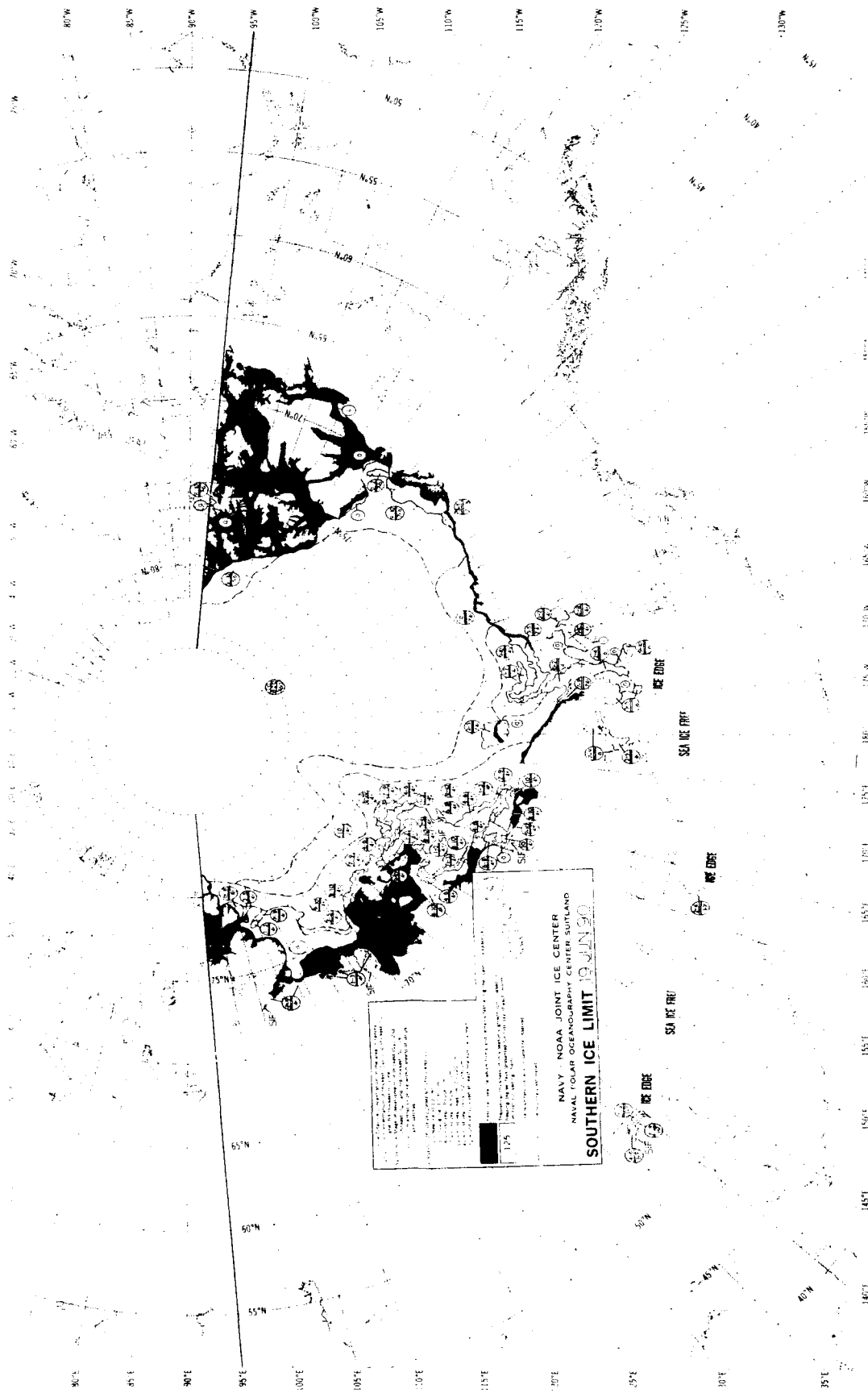


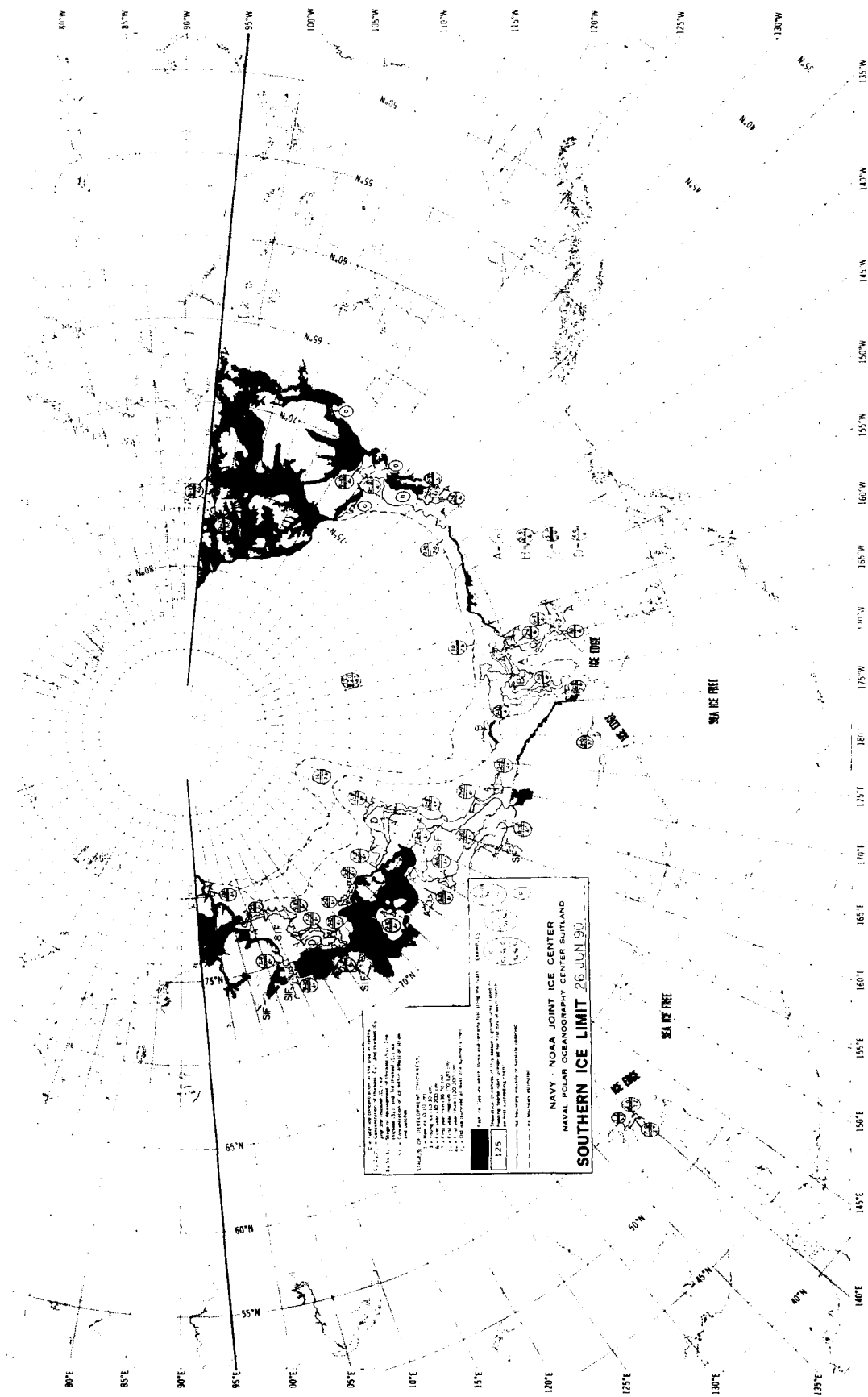
1. This map shows the ice limit for the month of May 1950. The ice limit is defined as the outer edge of the ice pack. The ice pack is the area of the Arctic Ocean which is covered by ice. The ice limit is shown by a solid line. The area between the ice limit and the coastline is the ice-free area. The area between the ice limit and the outer edge of the ice pack is the ice-covered area. The area between the ice limit and the outer edge of the ice pack is the ice-covered area. The area between the ice limit and the outer edge of the ice pack is the ice-covered area.

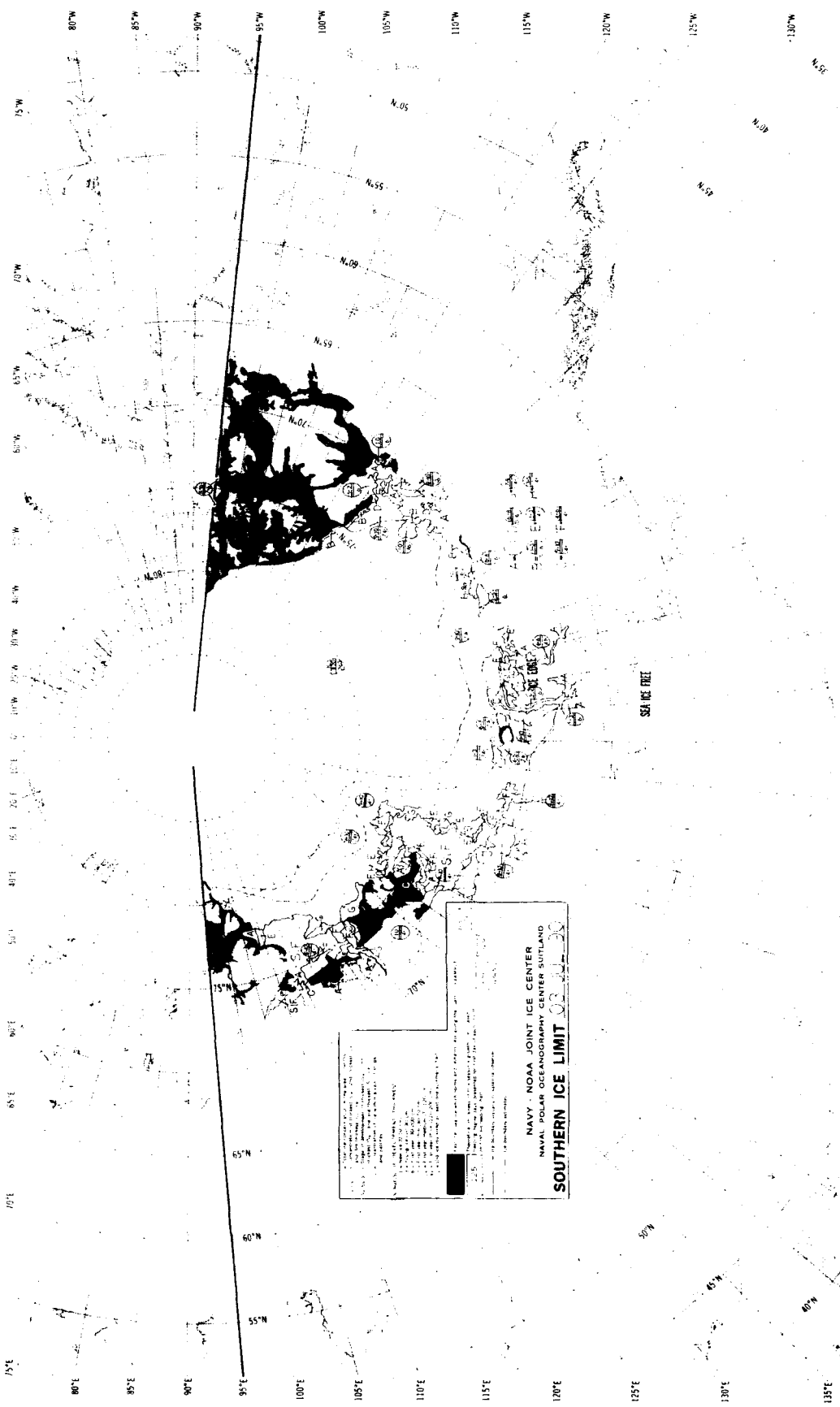
NAVY - NOAA JOINT ICE CENTER
 NAVAL POLAR OCEANOGRAPHY CENTER SUTLAND
SOUTHERN ICE LIMIT 29 MAY 50

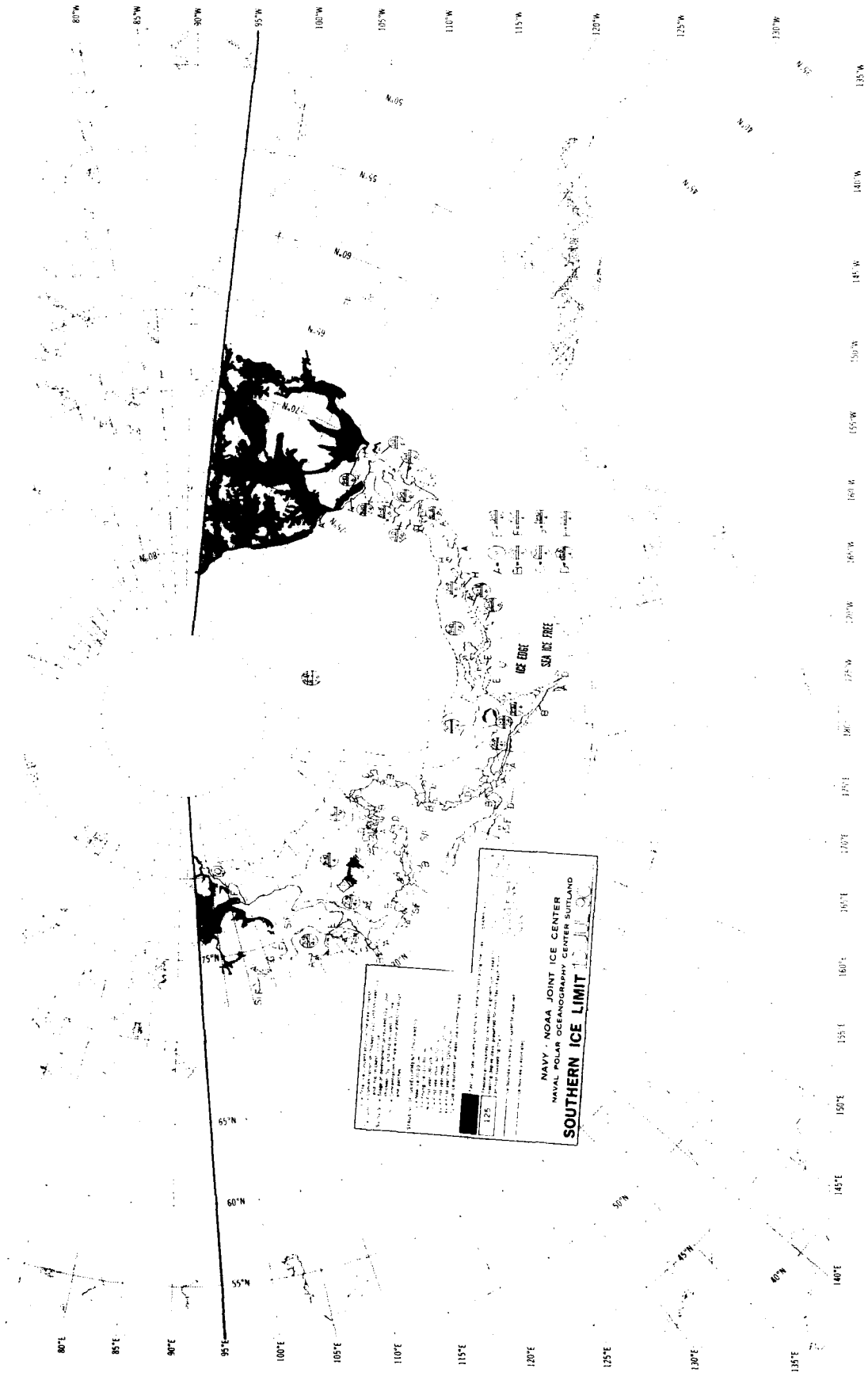




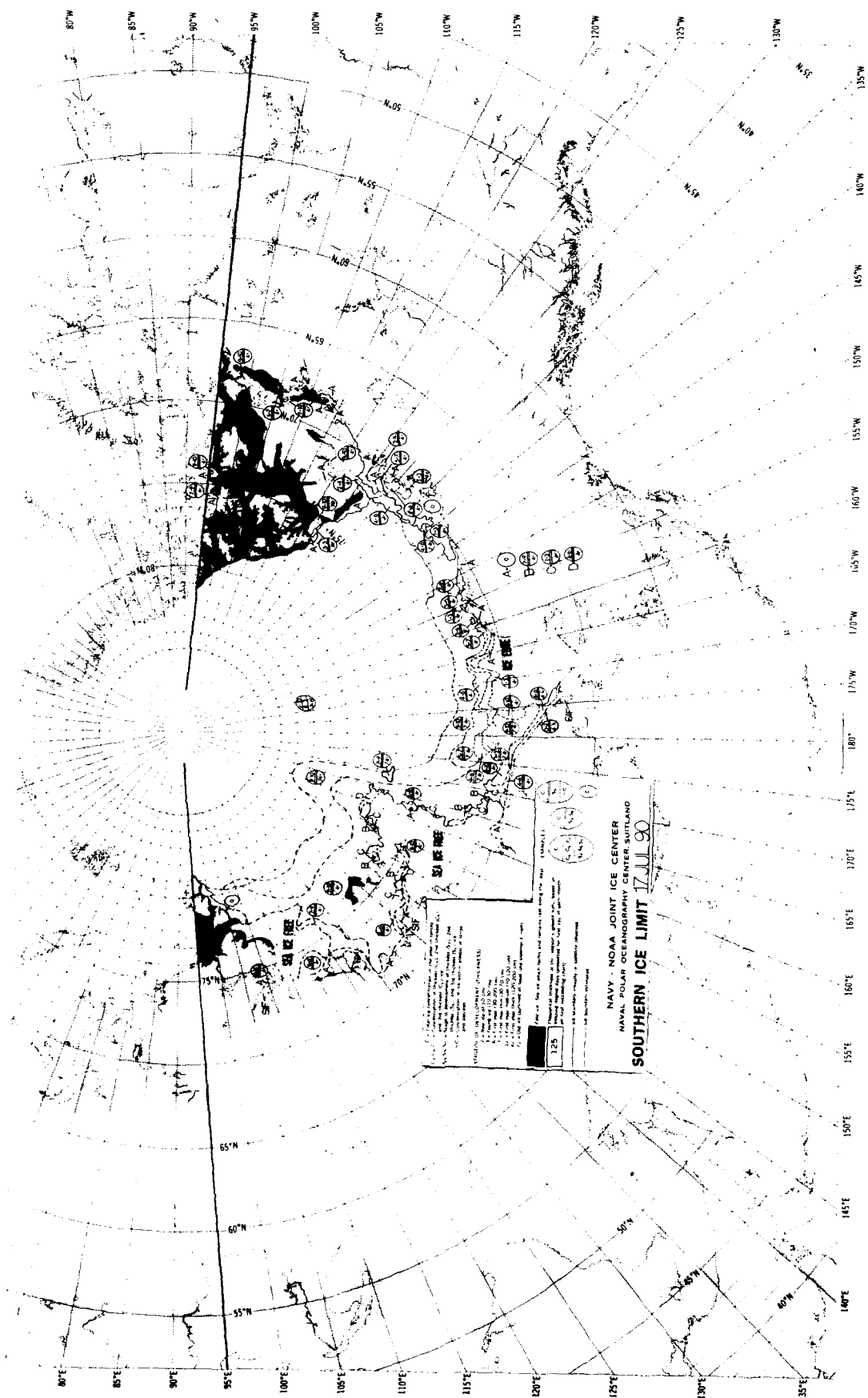


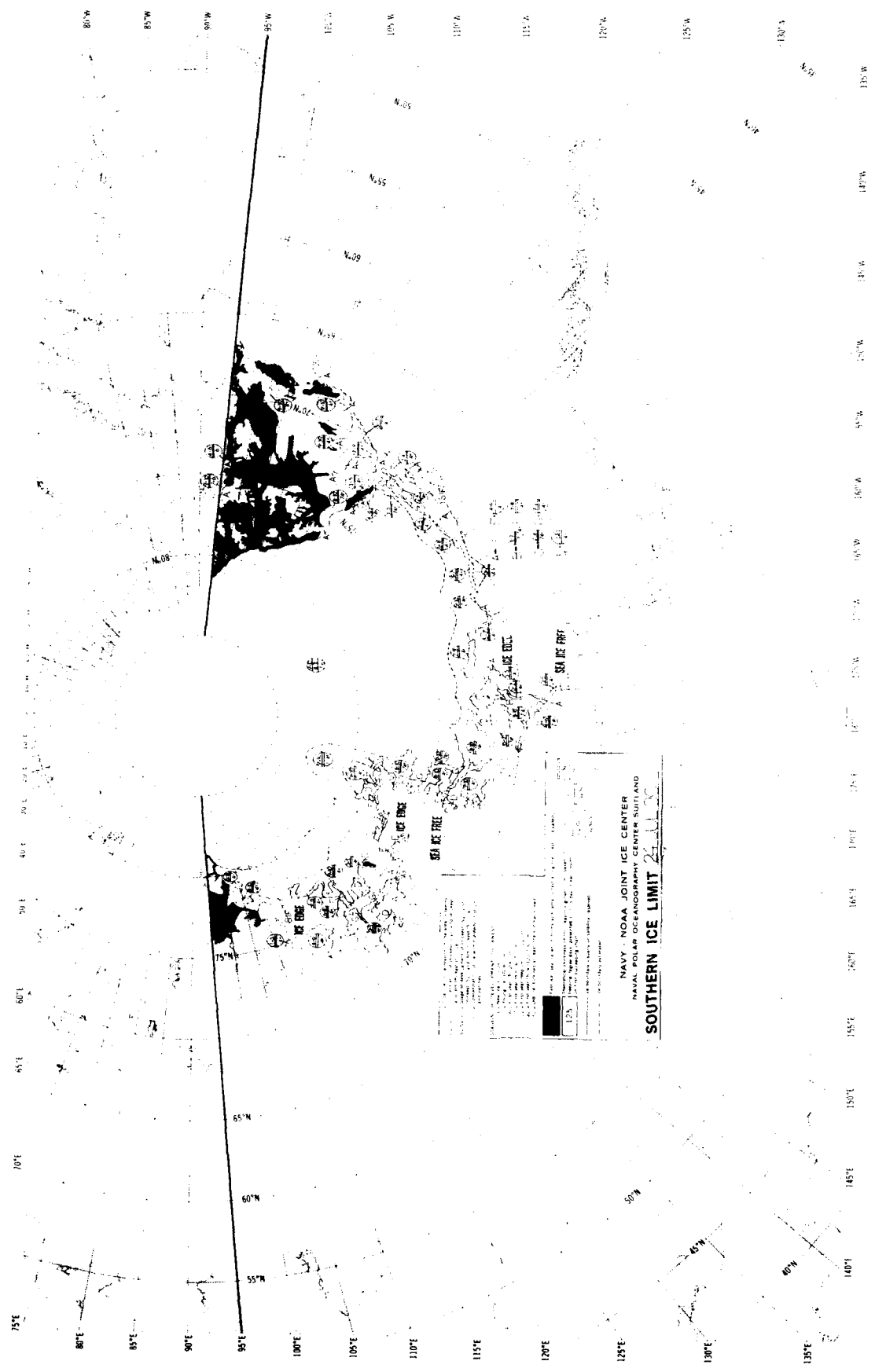




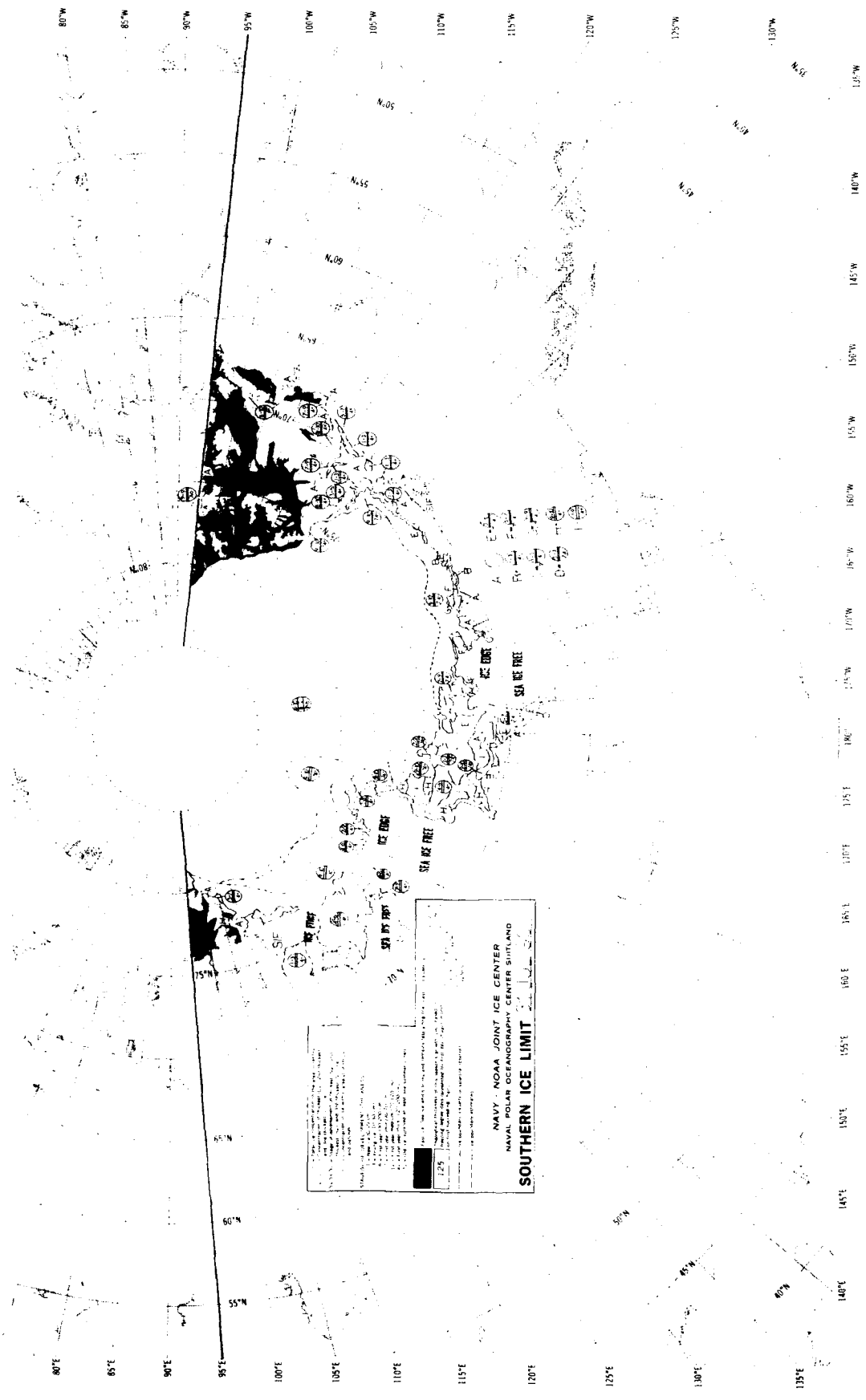


NAVY - NOAA JOINT ICE CENTER
NAVAL POLAR OCEANOGRAPHIC CENTER SUTLAND
SOUTHERN ICE LIMIT





NAVY - NOAA JOINT ICE CENTER
NAVAL POLAR OCEANOGRAPHY CENTER SUITLAND
SOUTHERN ICE LIMIT 25 JUL 68



NAVY - NOAA JOINT ICE CENTER
NAVAL POLAR OCEANOGRAPHY CENTER SUITLAND
SOUTHERN ICE LIMIT

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1. The ice limit is defined as the outer edge of the ice field. It is the line beyond which the ice concentration is less than 10%.

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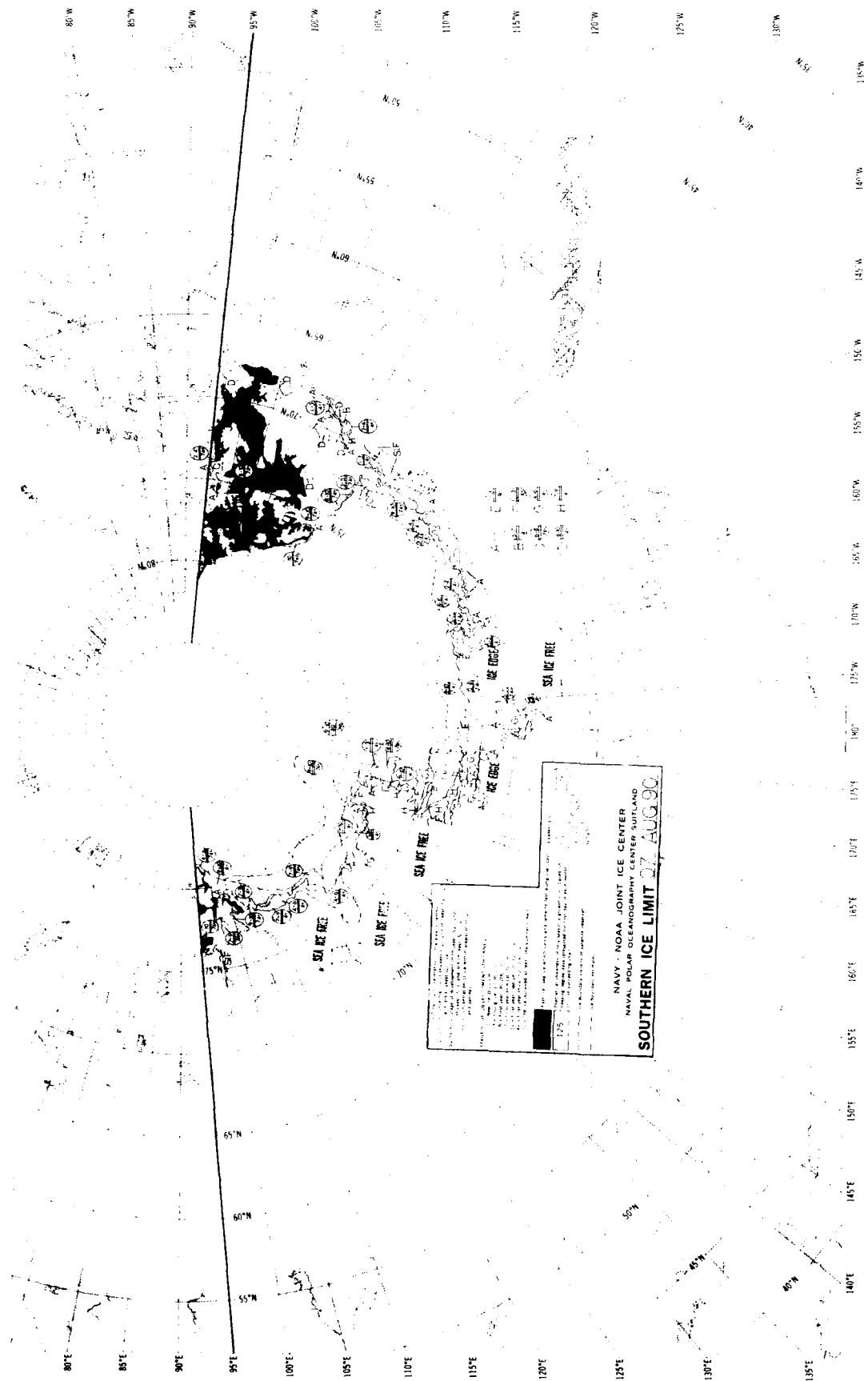
6. The ice limit is defined as the outer edge of the ice field. It is the line beyond which the ice concentration is less than 10%.

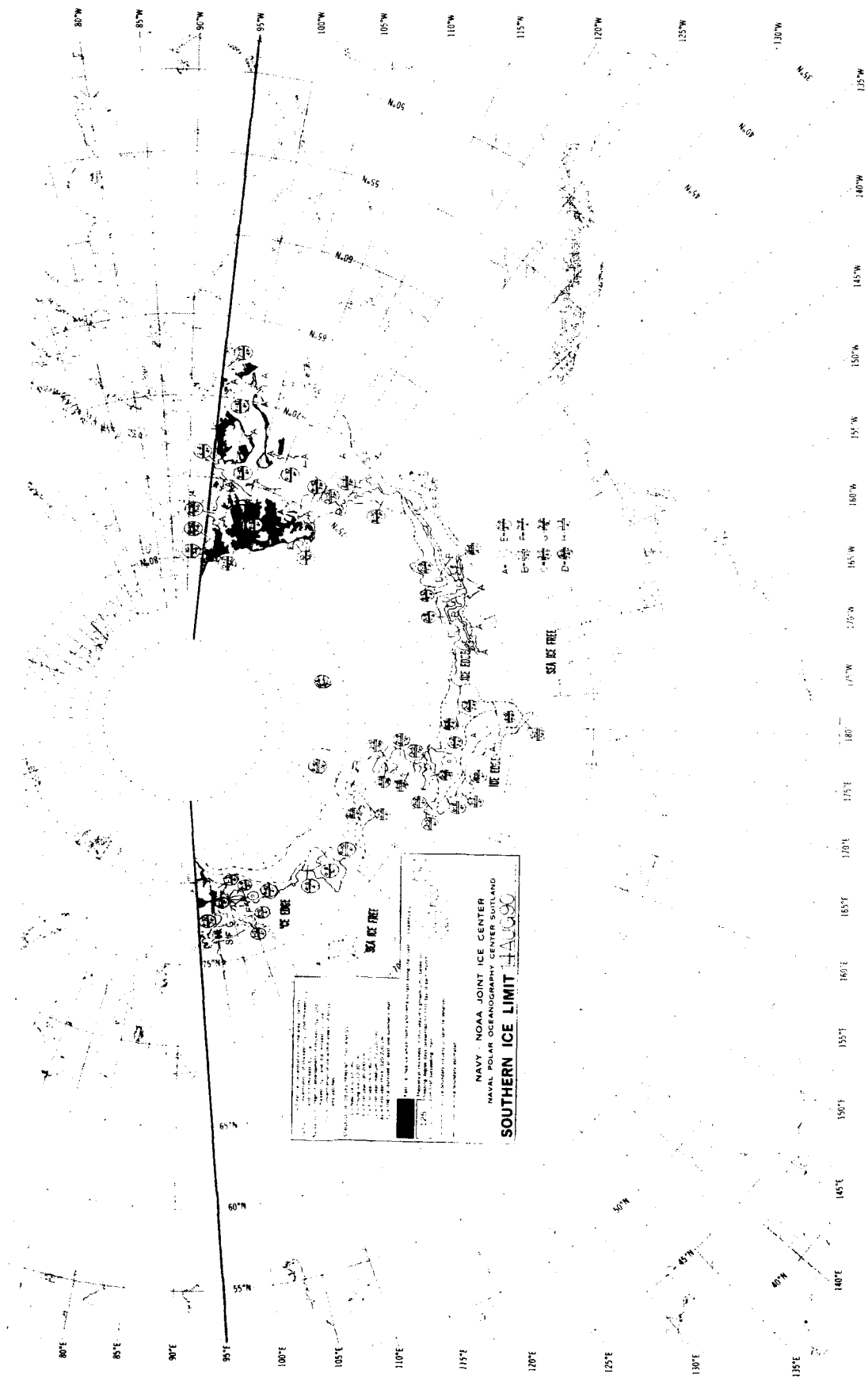
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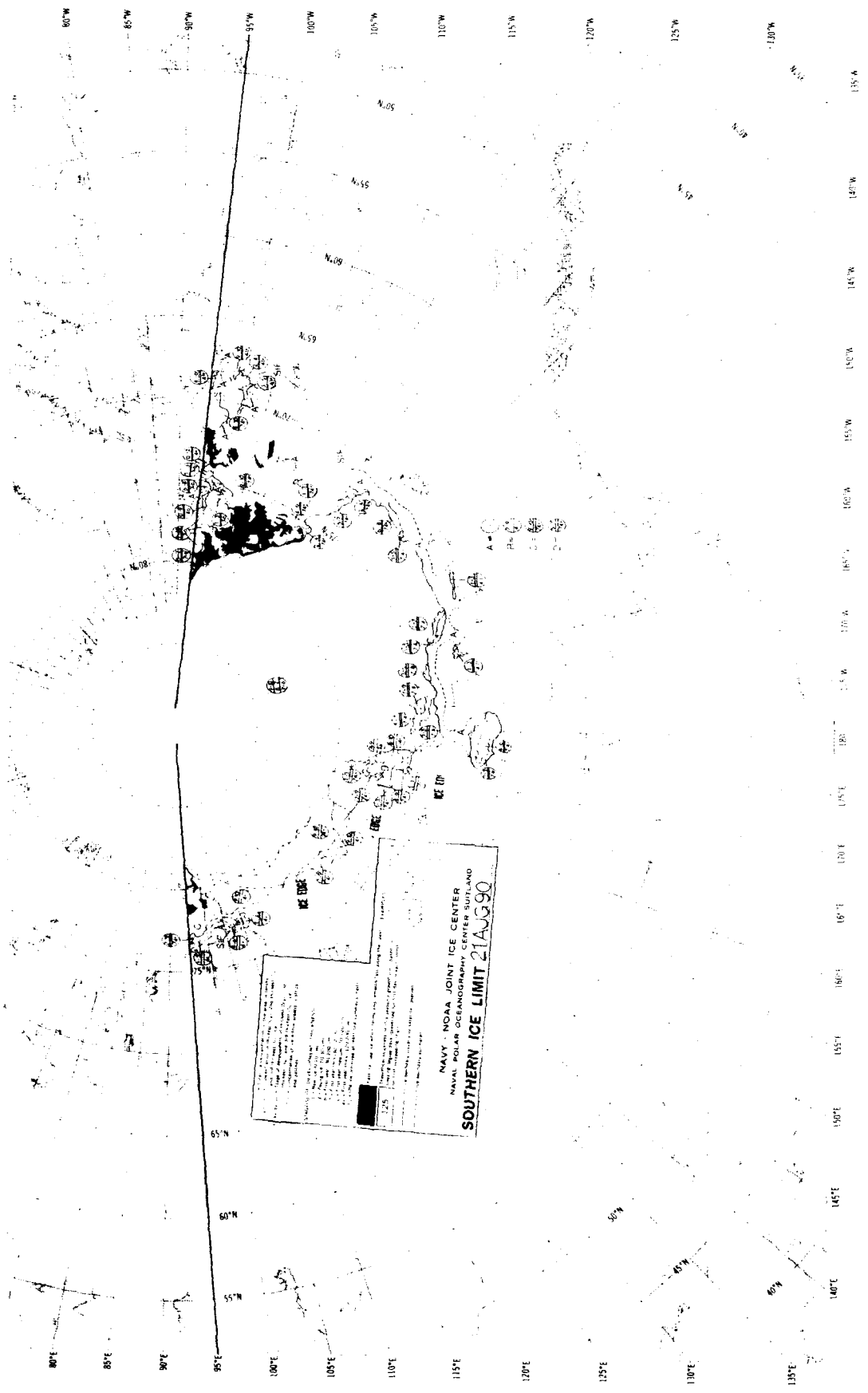
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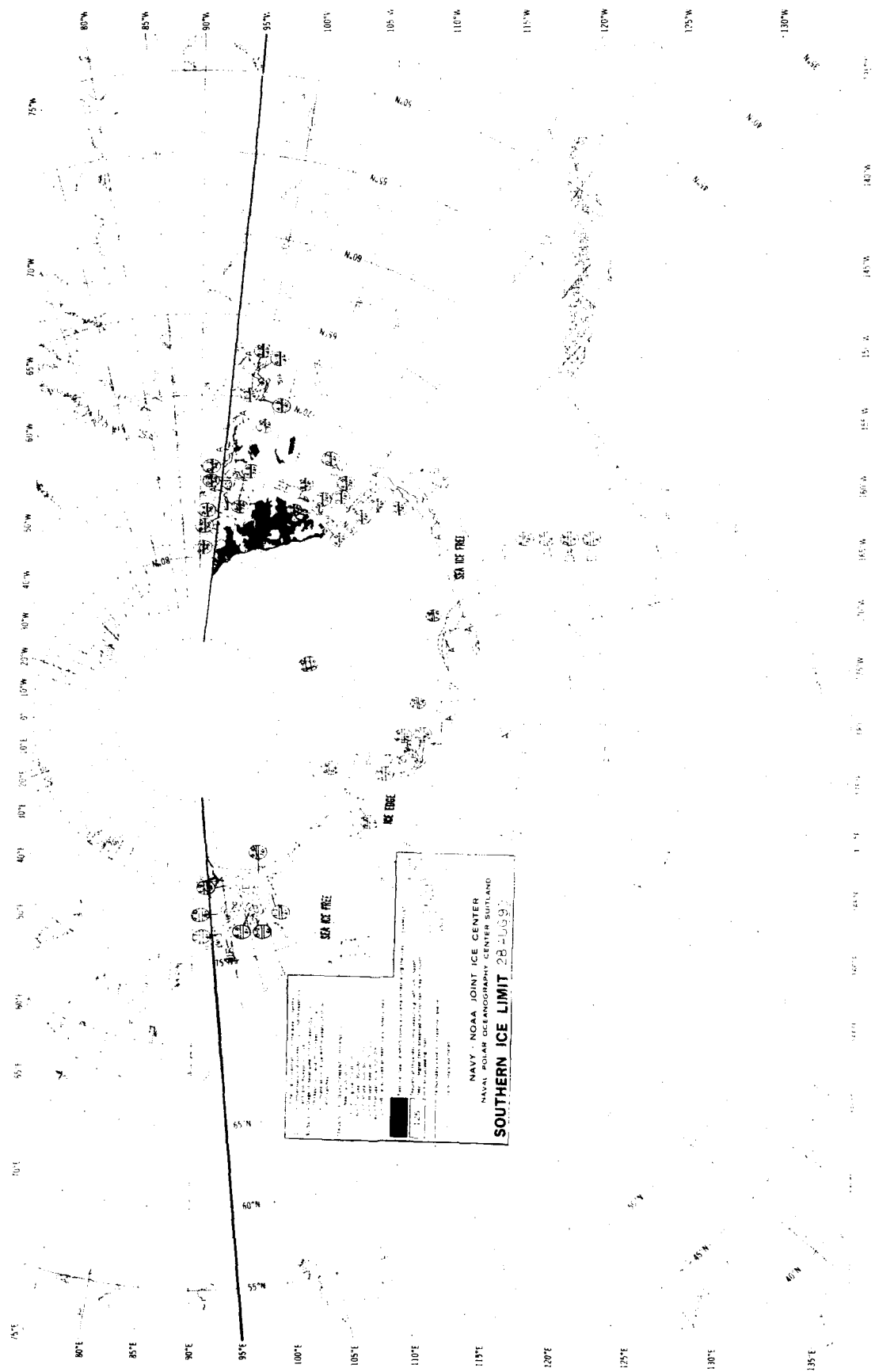
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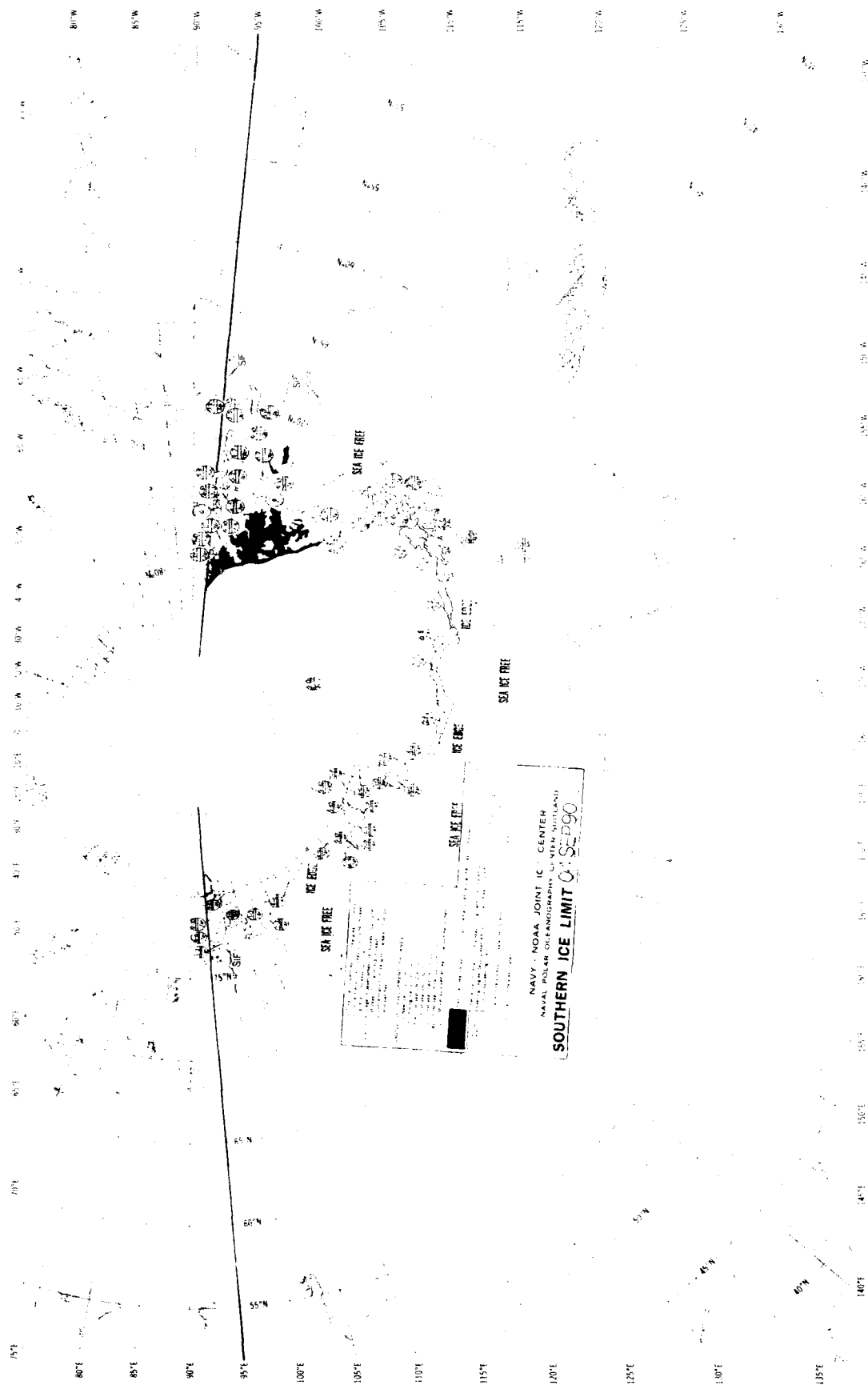
10. The ice limit is defined as the outer edge of the ice field. It is the line beyond which the ice concentration is less than 10%.

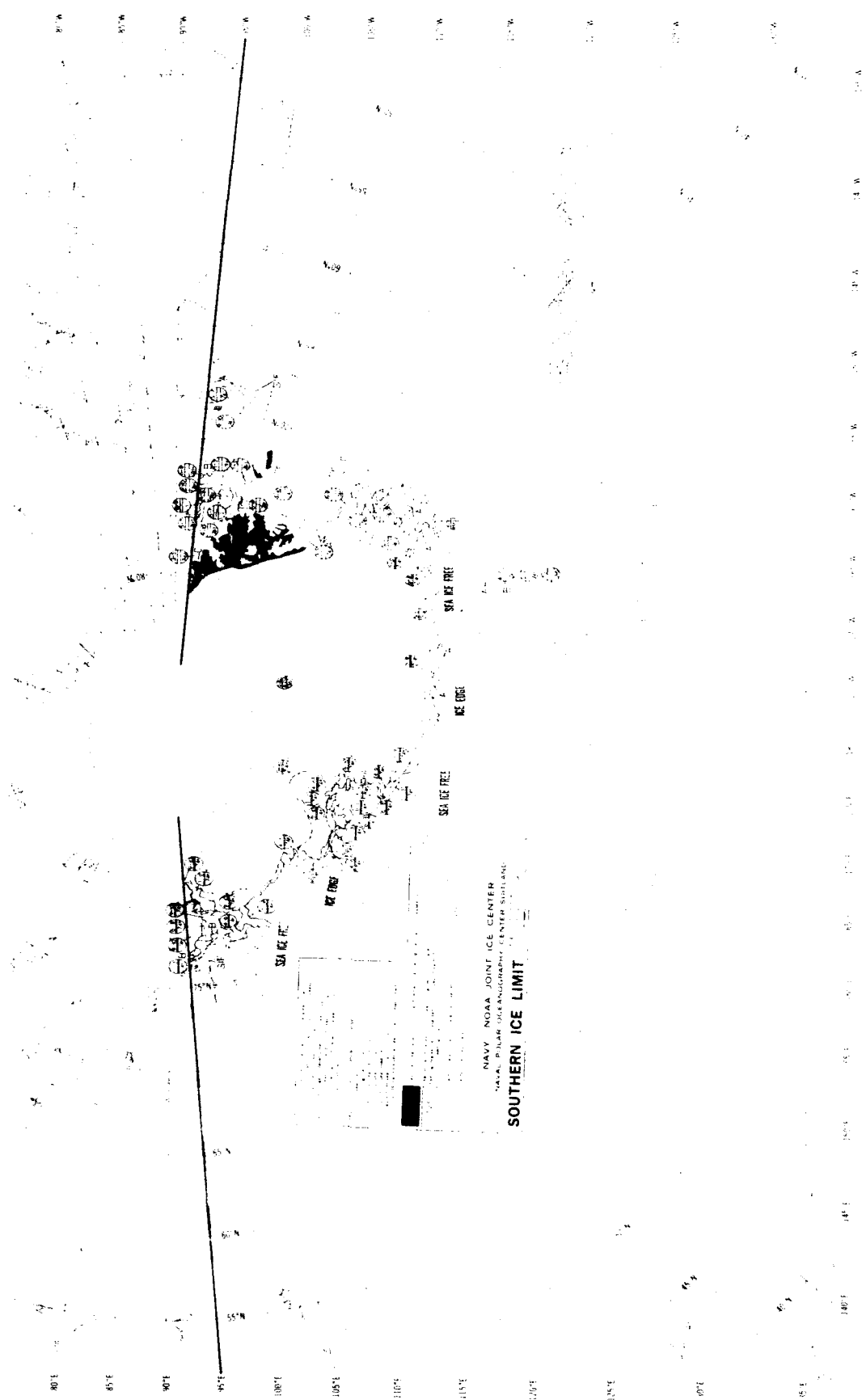


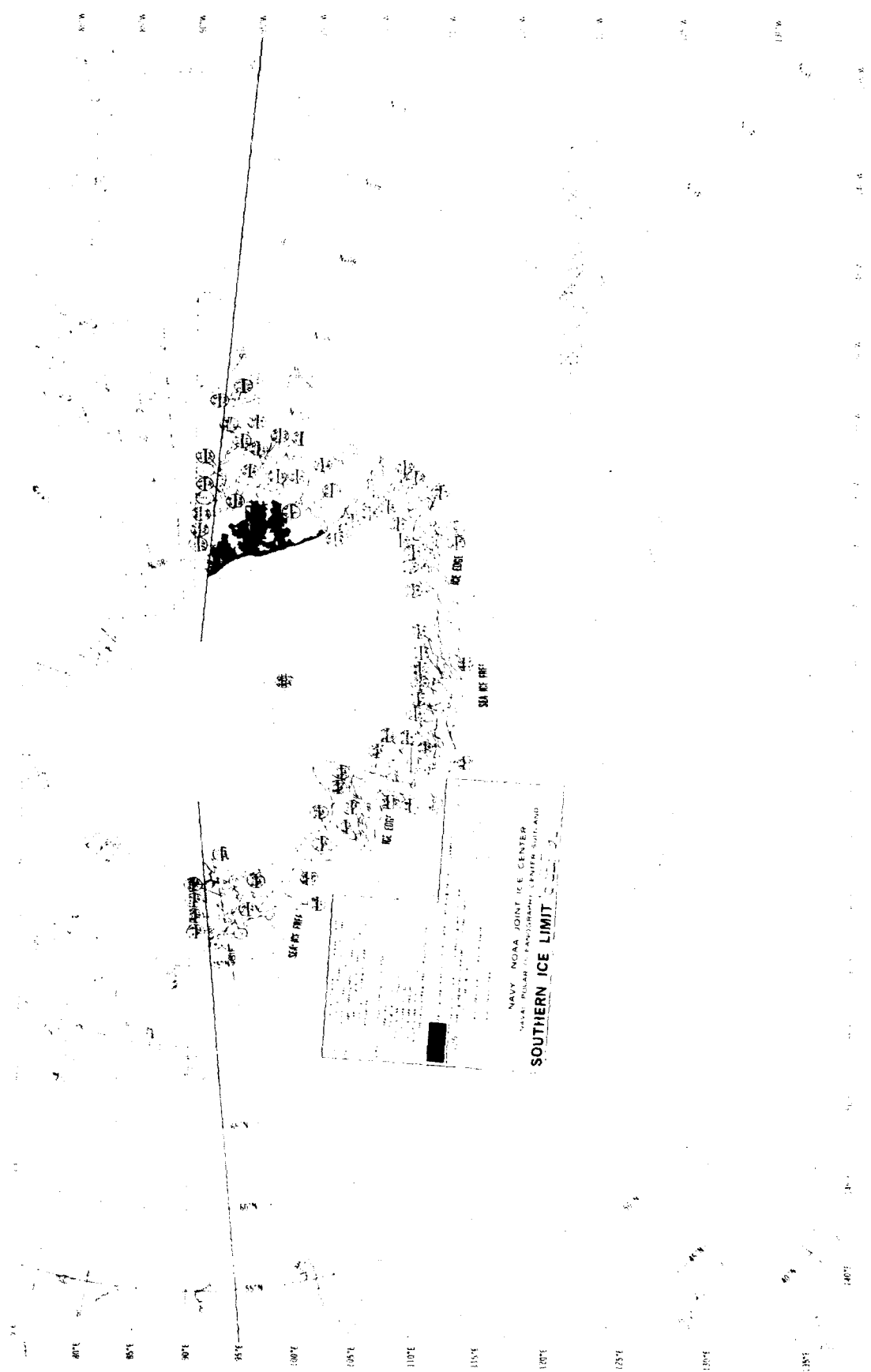


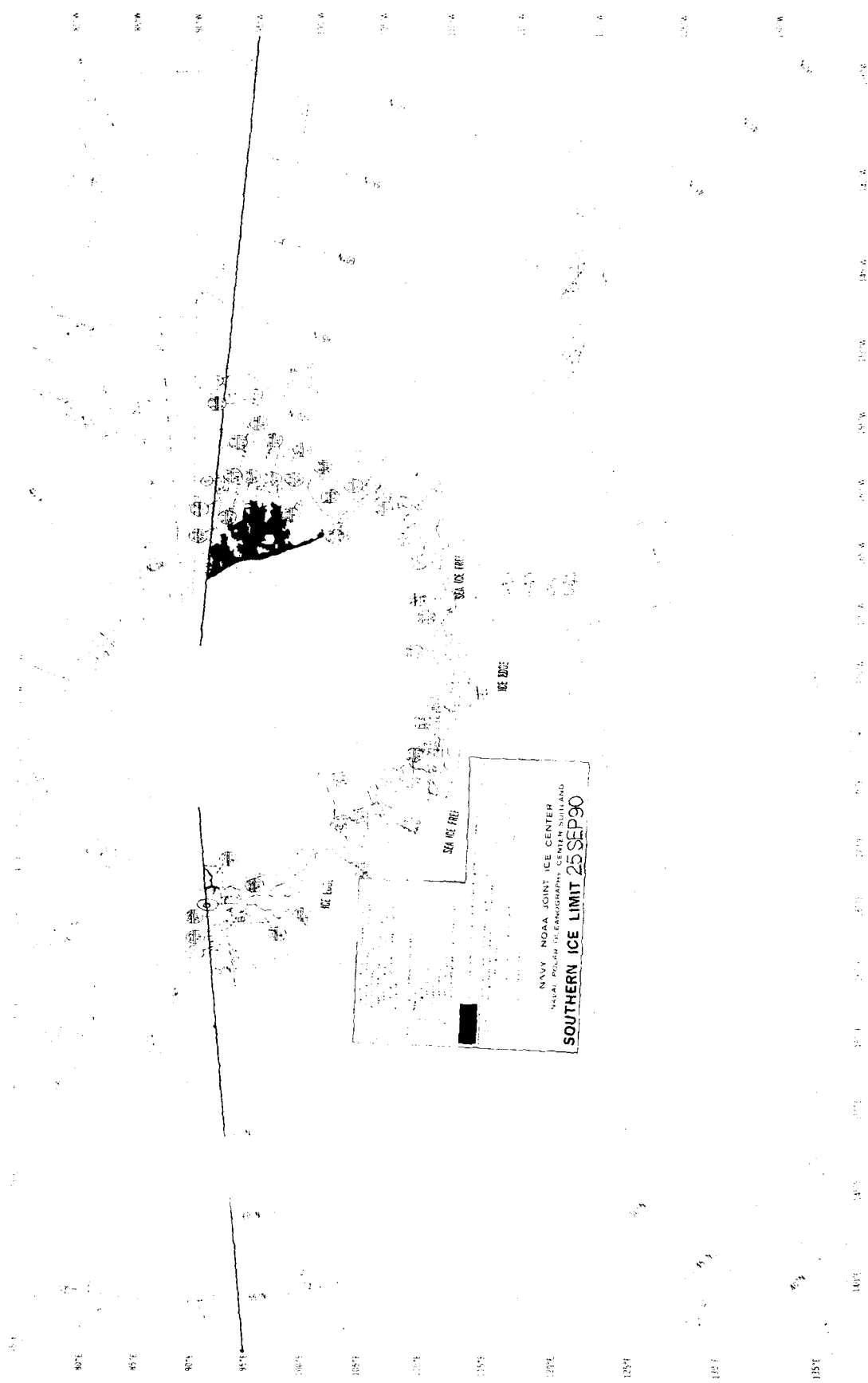


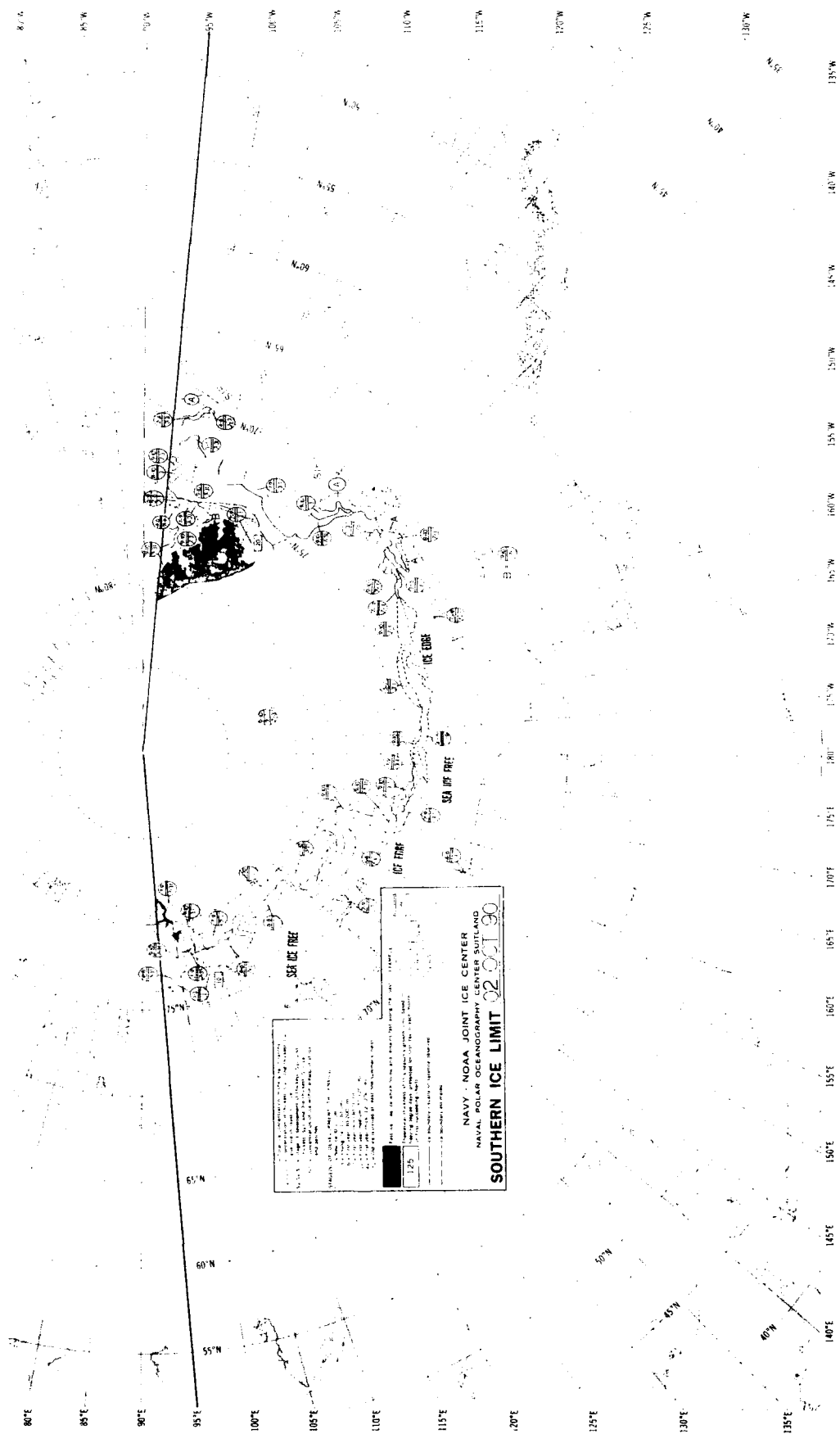


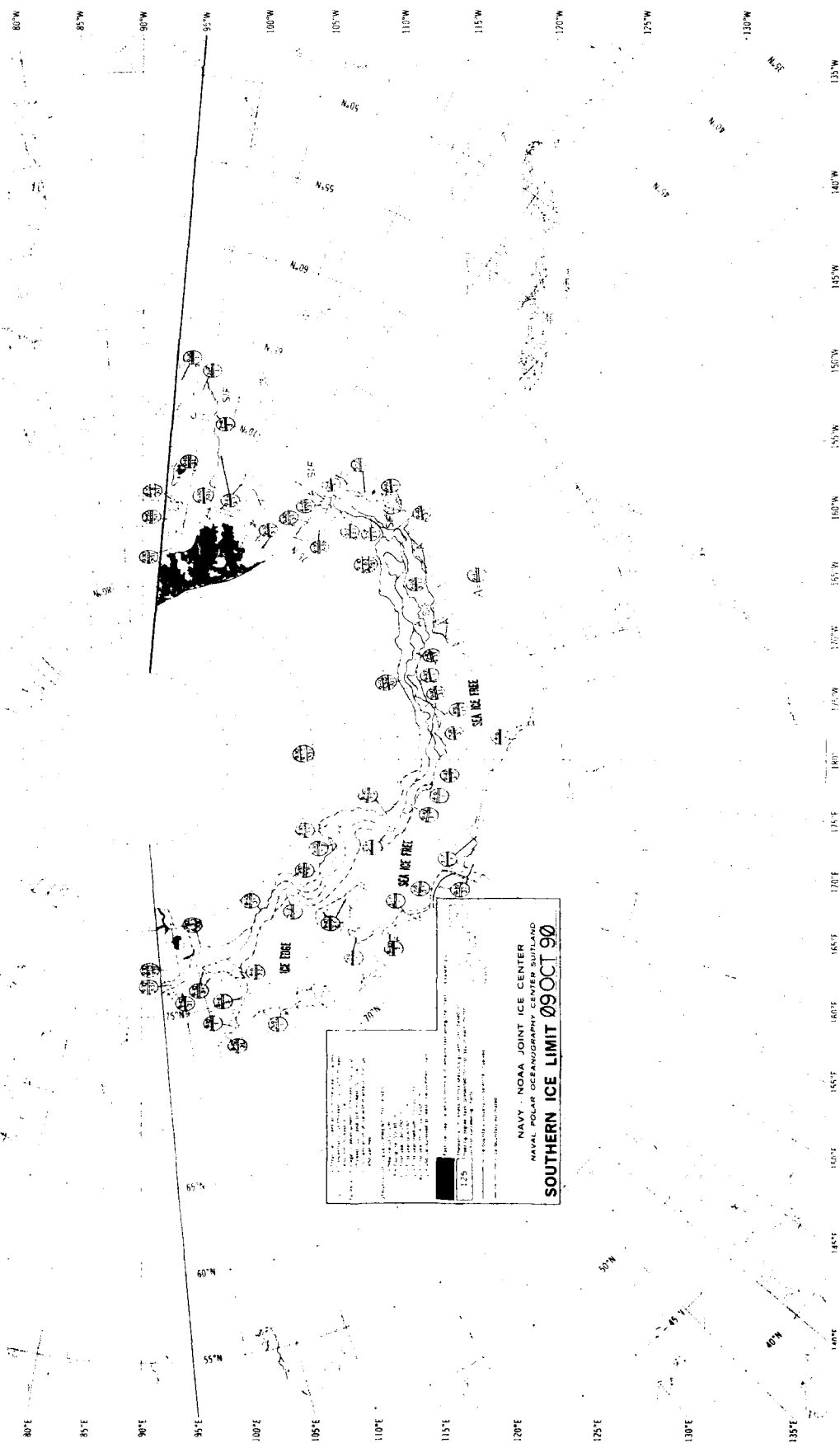




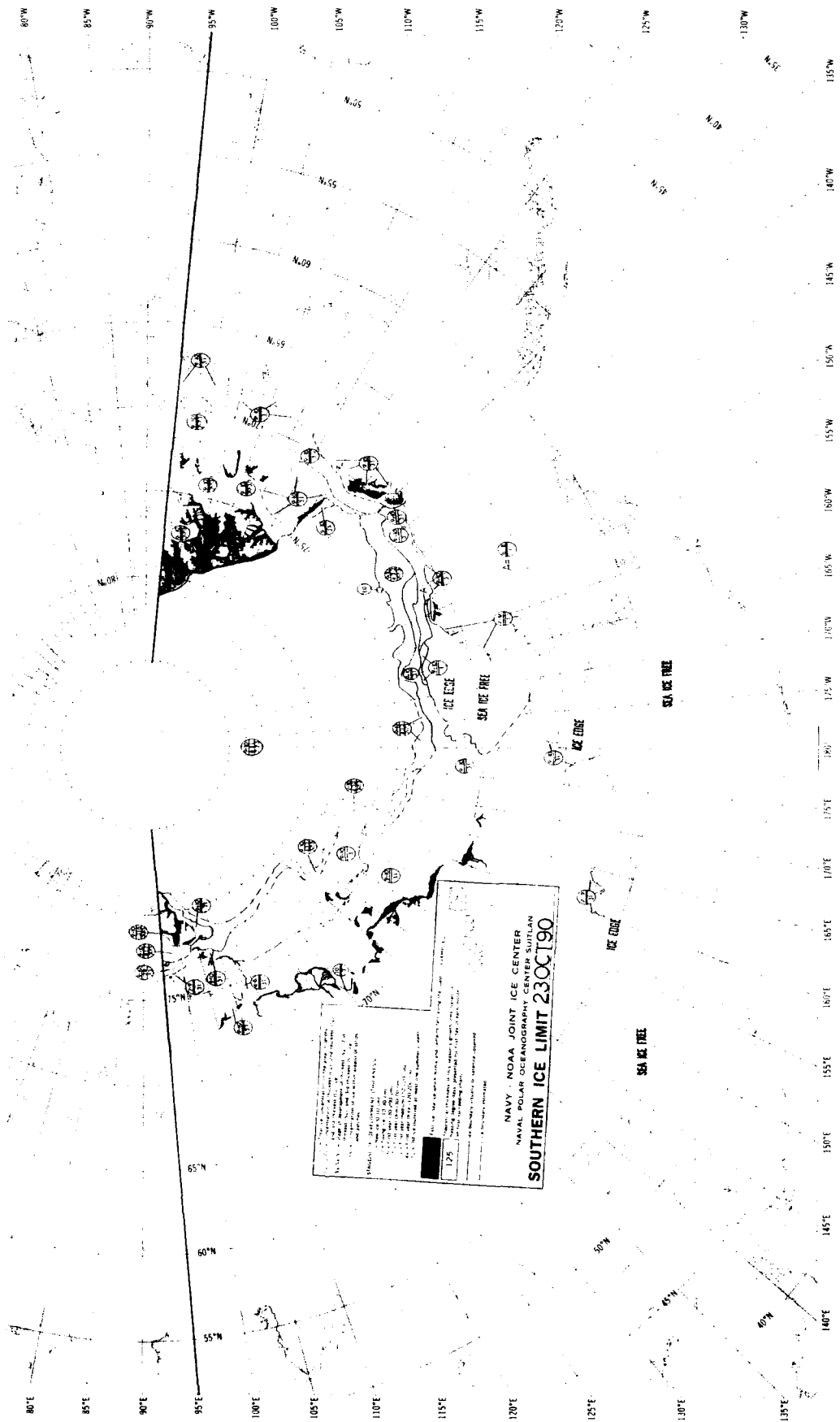


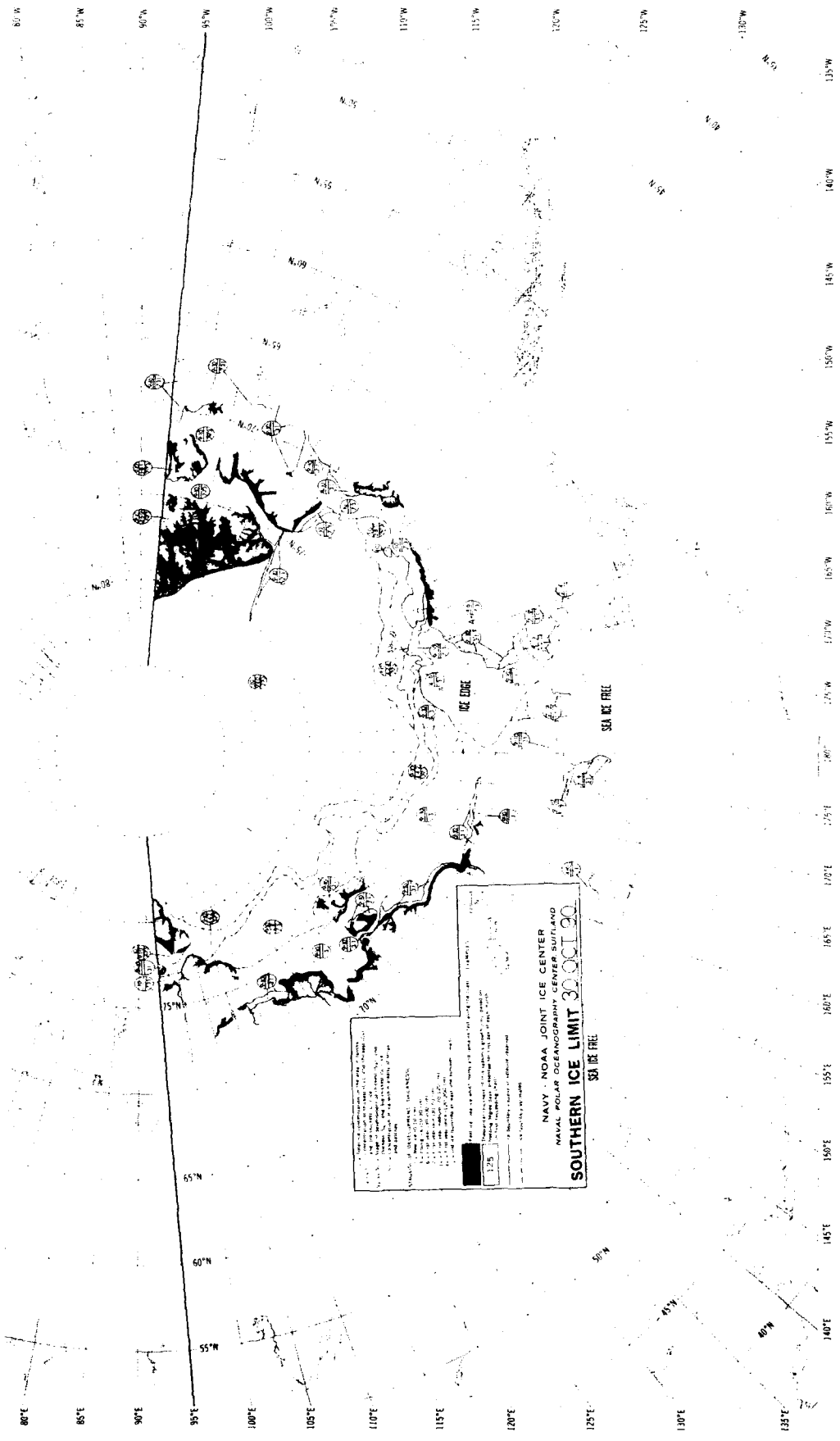


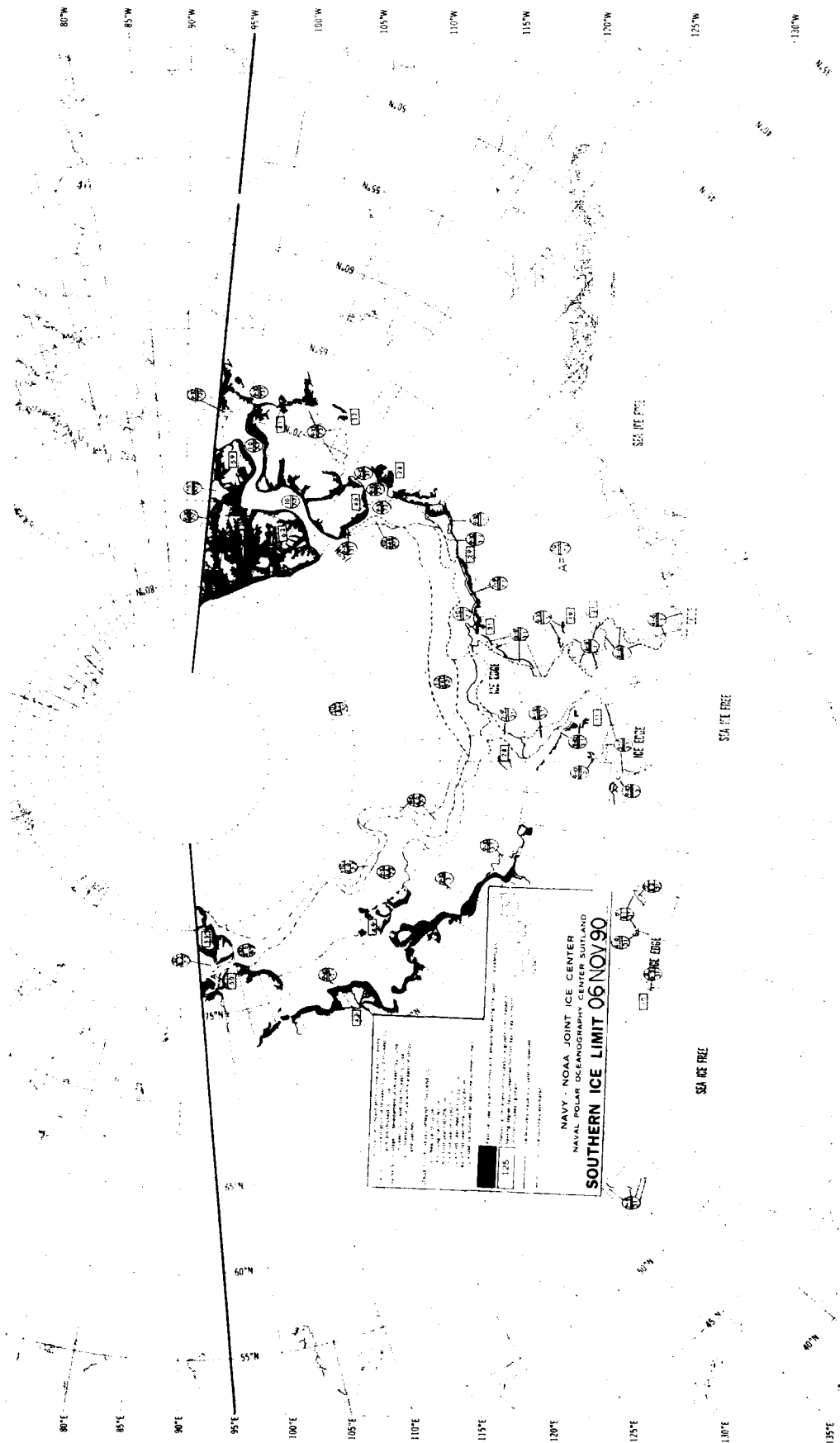


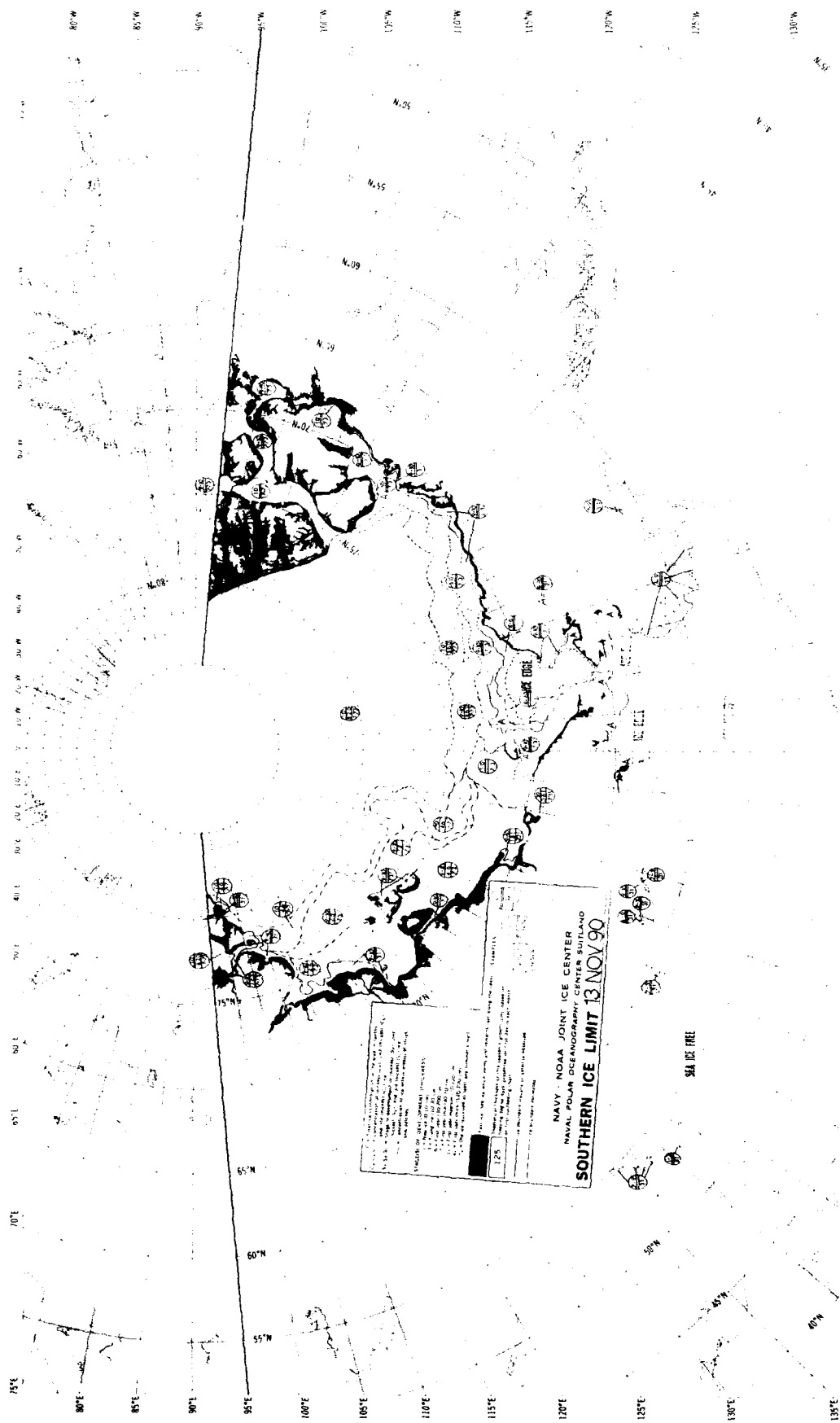


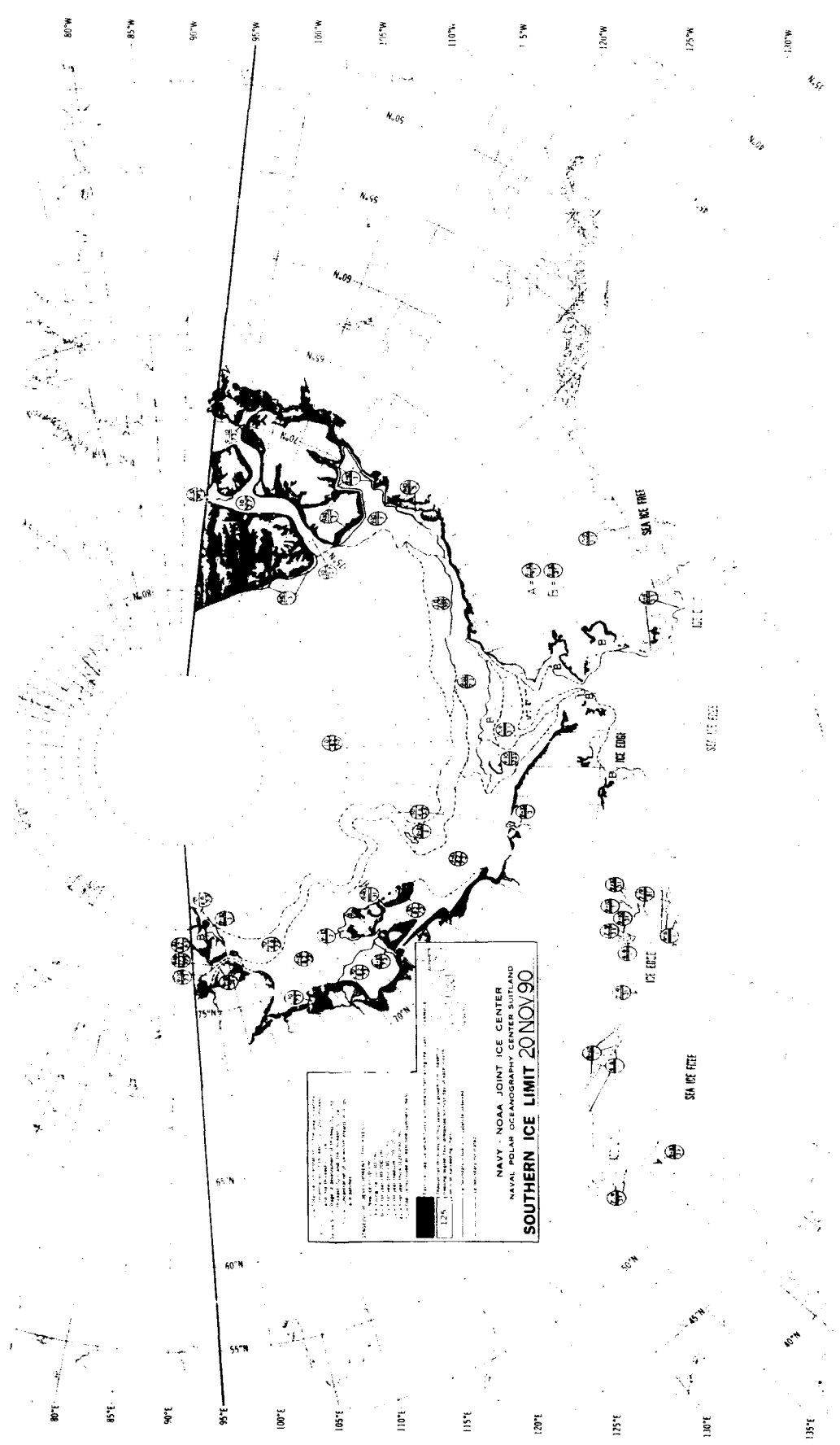






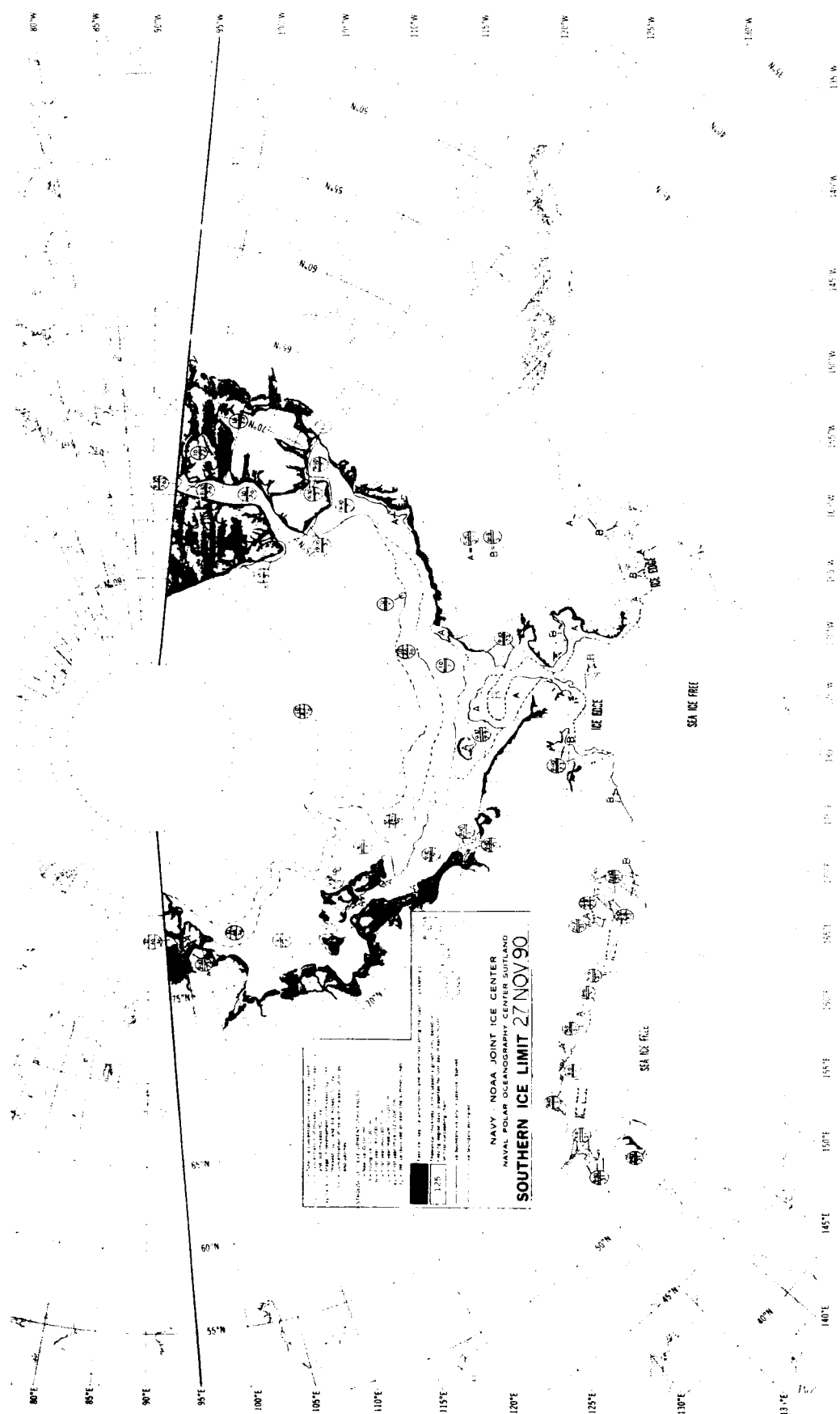


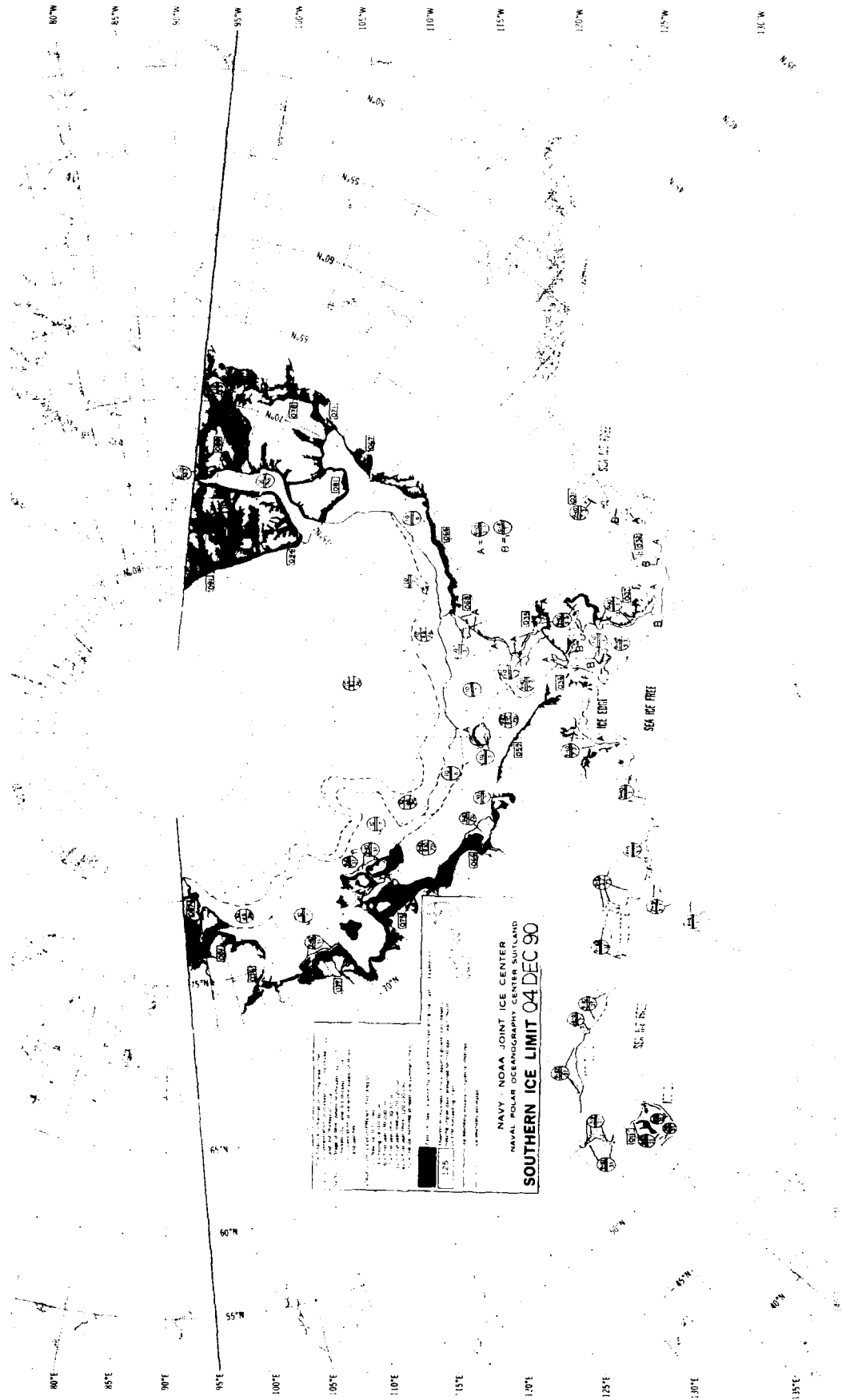


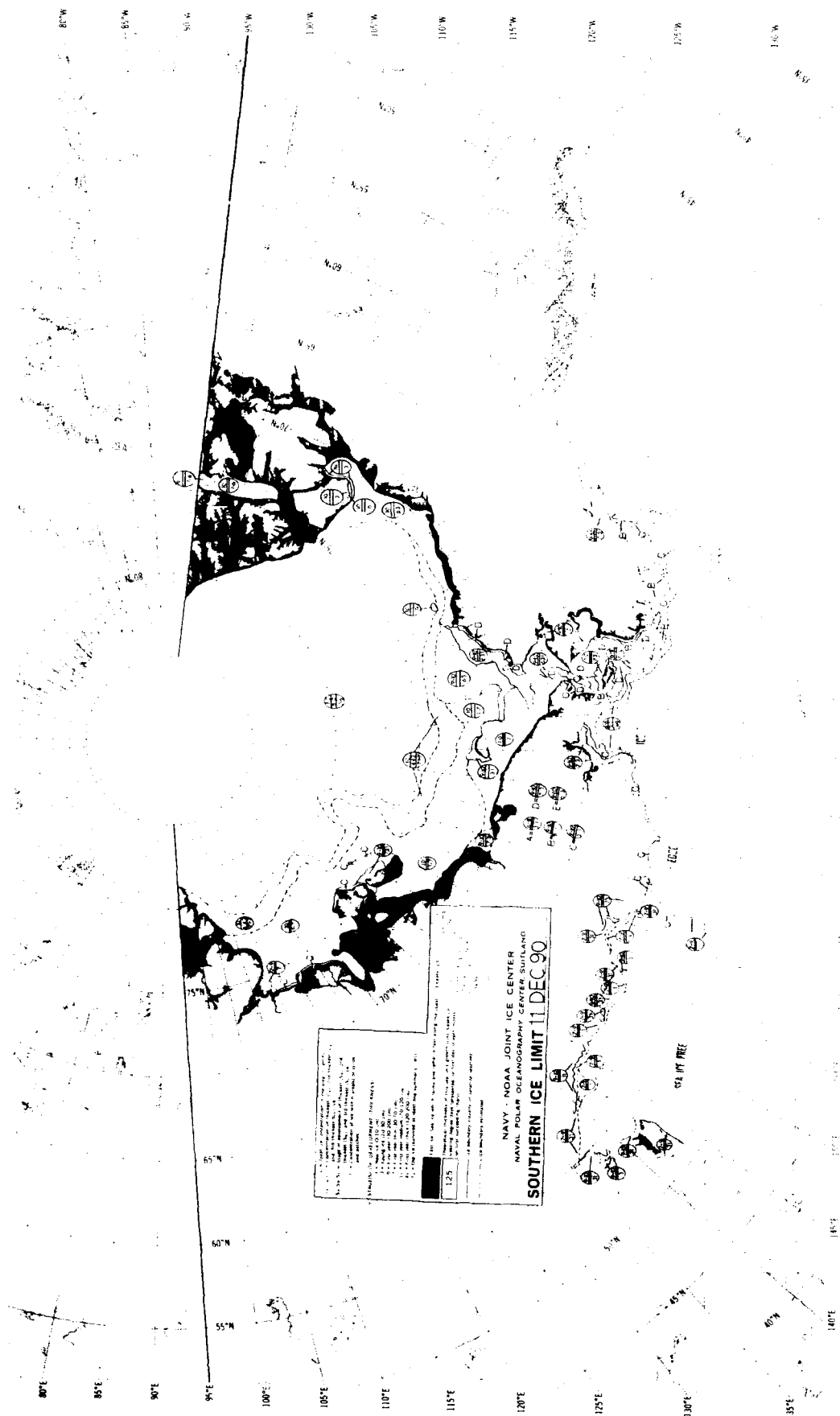


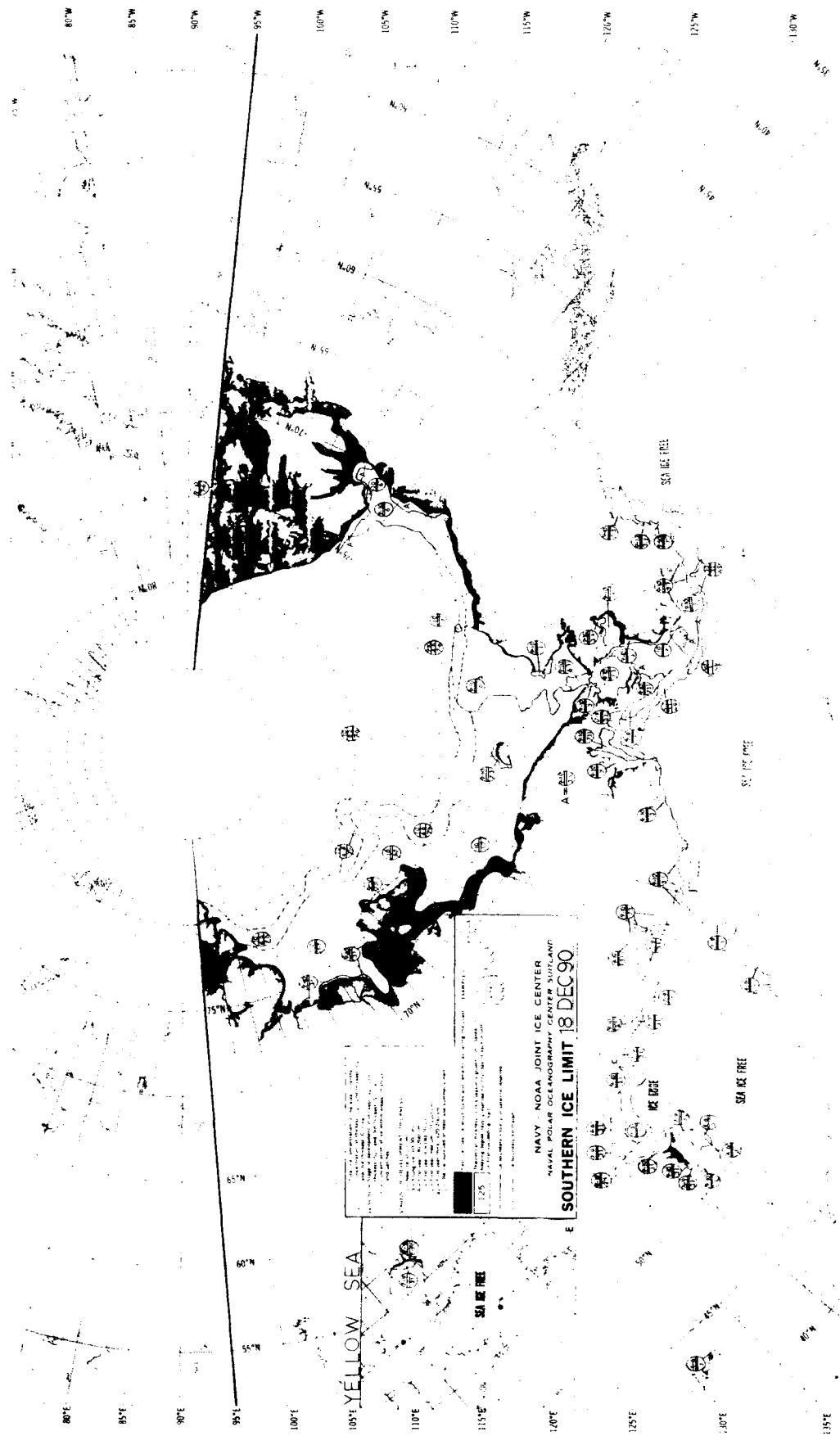
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NAVAL POLAR OCEANOGRAPHY CENTER SUTLAND
SOUTHERN ICE LIMIT 20 NOV 90

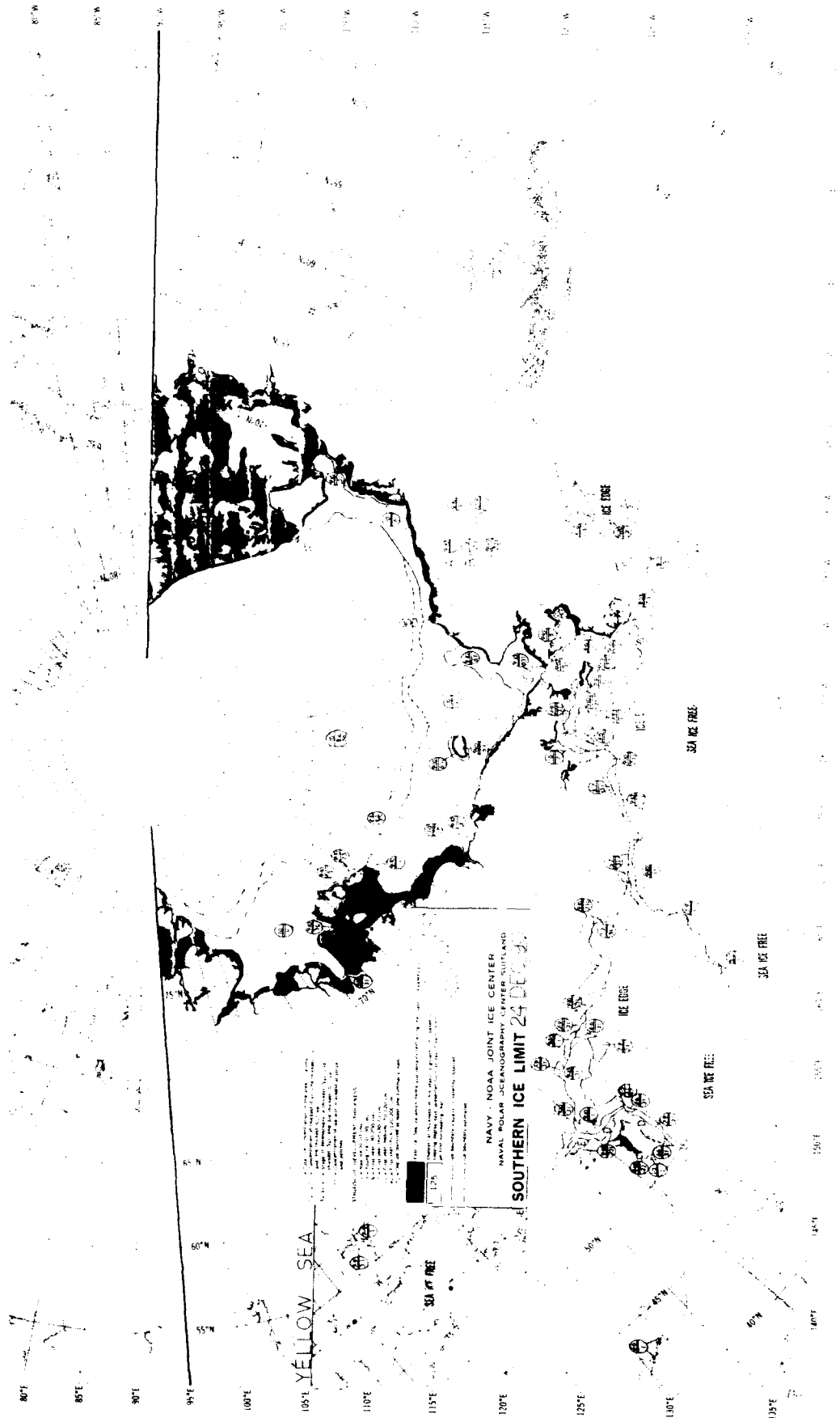
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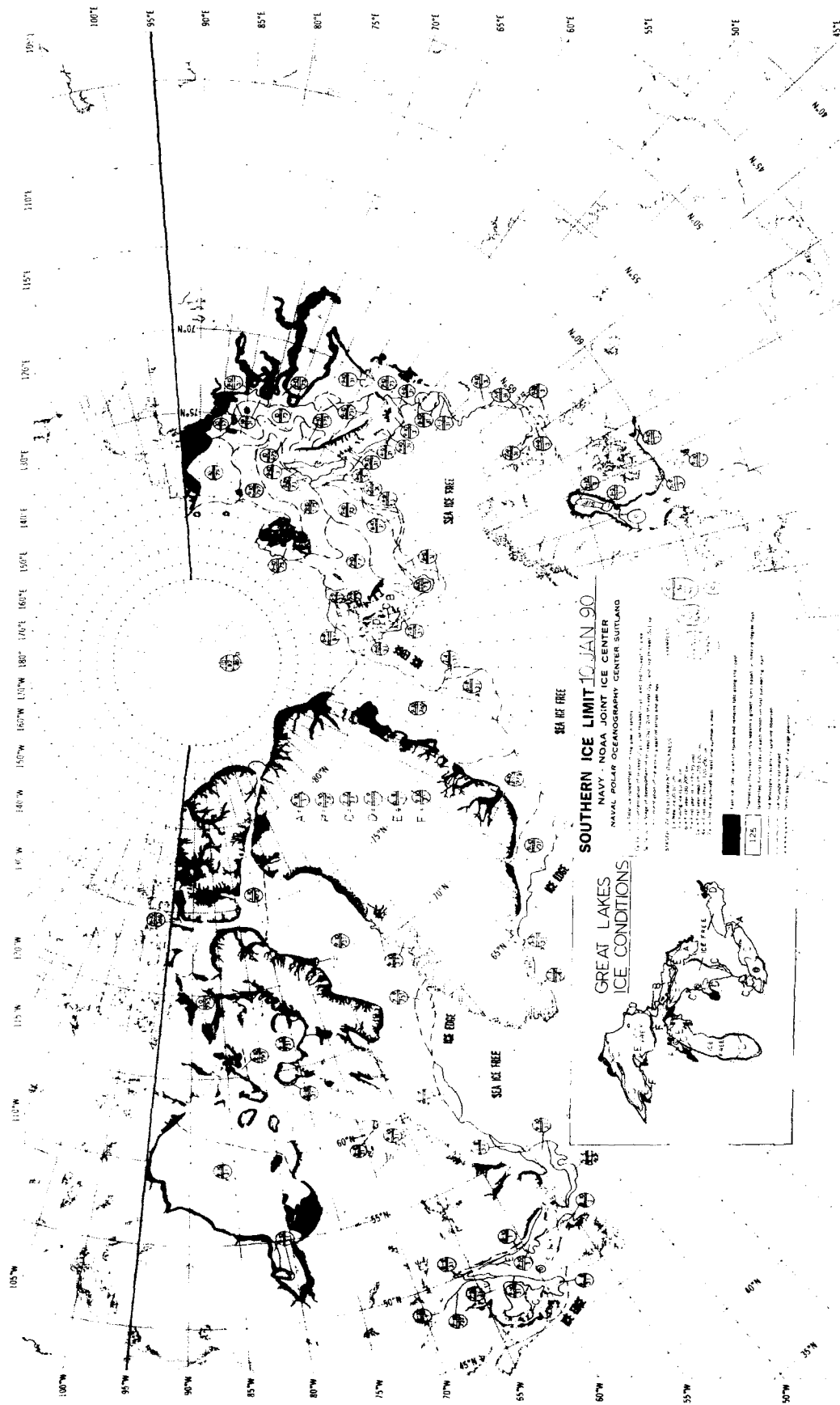


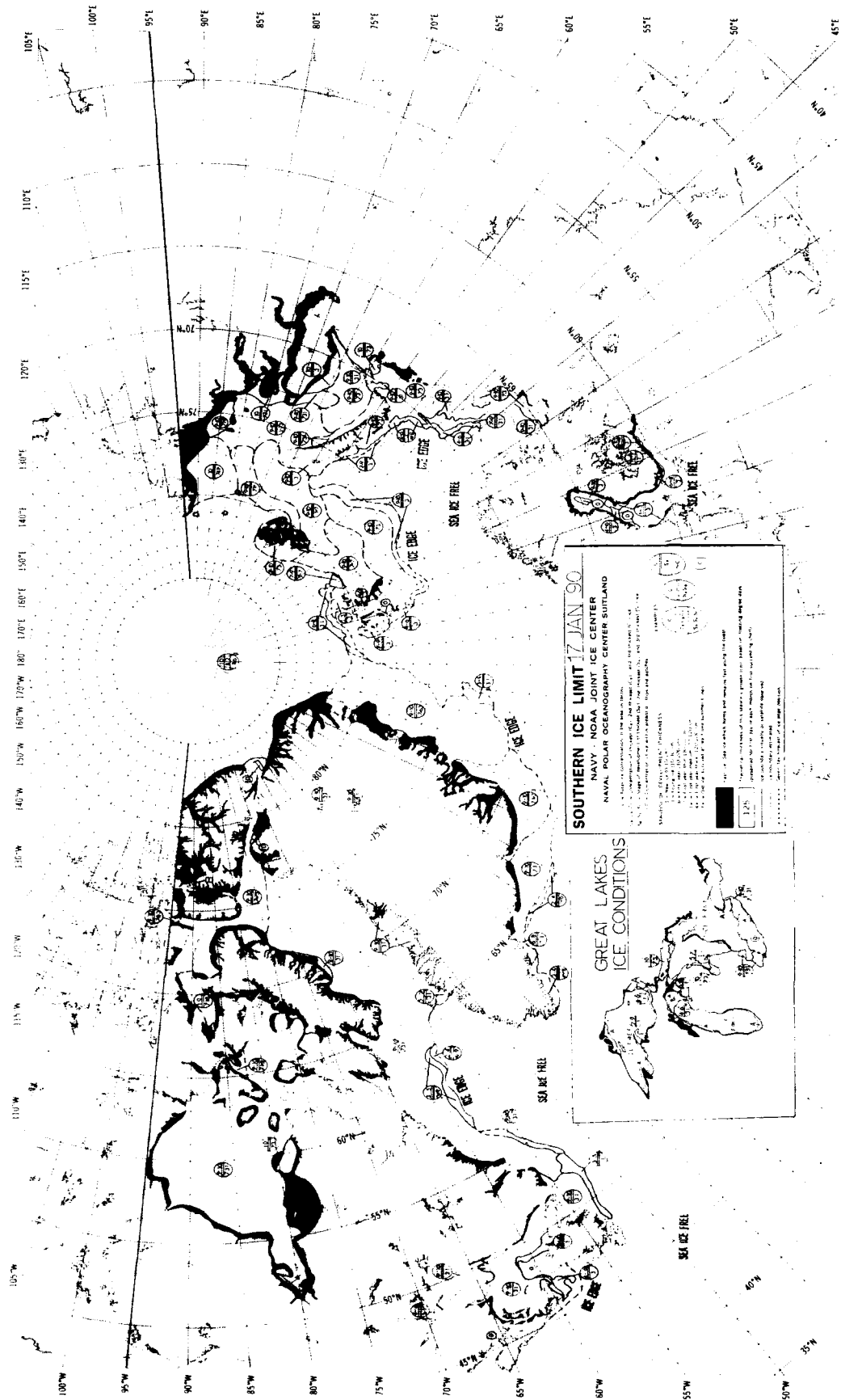












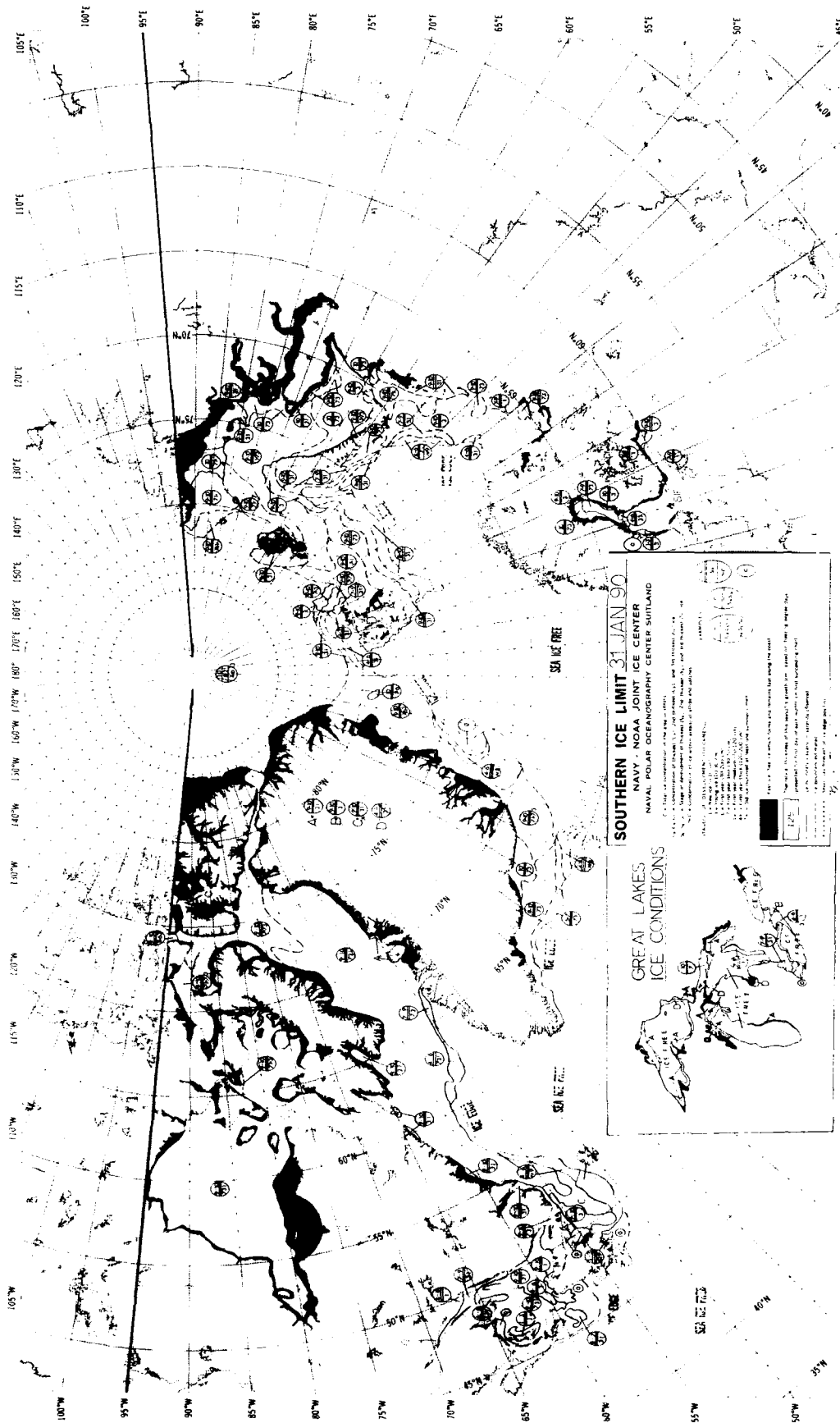
SOUTHERN ICE LIMIT 17 JAN 90

NAVY - NOAA JOINT ICE CENTER
NAVAL POLAR OCEANOGRAPHY CENTER SUTLAND

1. Data is contributed by the following sources:
a. U.S. Navy - Fleet Weather Centers (FWCs) and Fleet Ice Centers (FICs)
b. U.S. Navy - Naval Oceanographic Office (NOO)
c. U.S. Navy - Naval Hydrographic Office (NHO)
d. U.S. Navy - Naval Air Station (NAS)
e. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
f. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
g. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
h. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
i. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
j. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
k. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
l. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
m. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
n. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
o. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
p. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
q. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
r. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
s. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
t. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
u. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
v. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
w. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
x. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
y. U.S. Navy - Naval Facilities Engineering Command (NAFENG)
z. U.S. Navy - Naval Facilities Engineering Command (NAFENG)

GREAT LAKES
ICE CONDITIONS





SOUTHERN ICE LIMIT 31 JAN 90
 NAVY - NOAA JOINT ICE CENTER
 NAVAL POLAR OCEANOGRAPHY CENTER SUTLAND

1. This map is intended for use in the Great Lakes region only. It is not to be used for navigation or other purposes outside this region.

2. The map is based on data collected from various sources, including the Navy, NOAA, and other agencies. It is not a guarantee of accuracy.

3. The map is subject to change without notice. It is not to be used for legal or other purposes.

4. The map is the property of the Navy and is not to be distributed outside the Navy.

5. The map is not to be used for any other purpose without the written permission of the Navy.

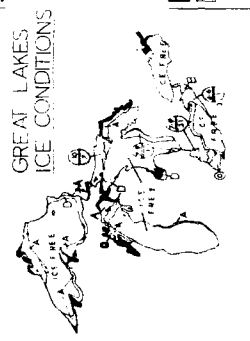
6. The map is not to be used for any other purpose without the written permission of the Navy.

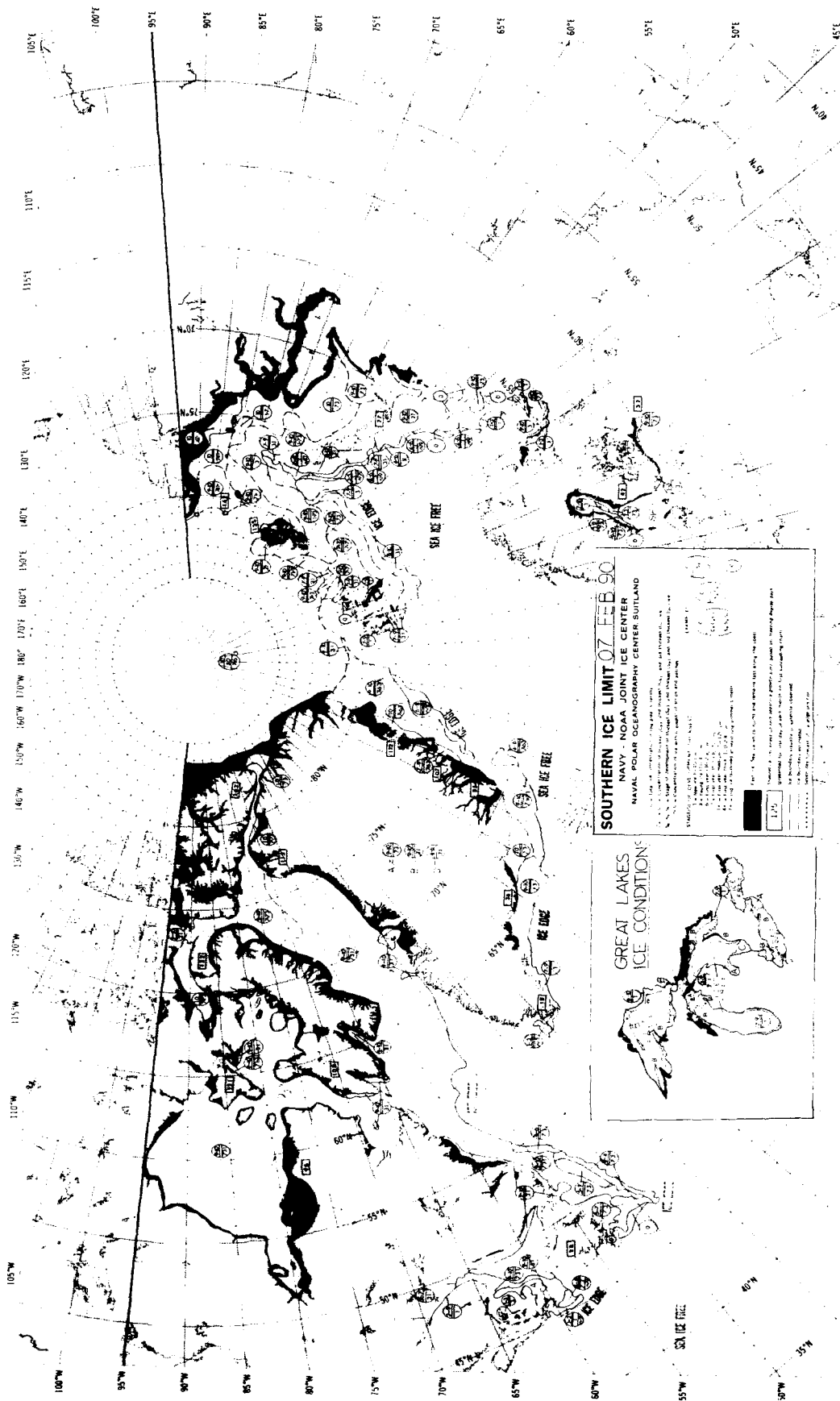
7. The map is not to be used for any other purpose without the written permission of the Navy.

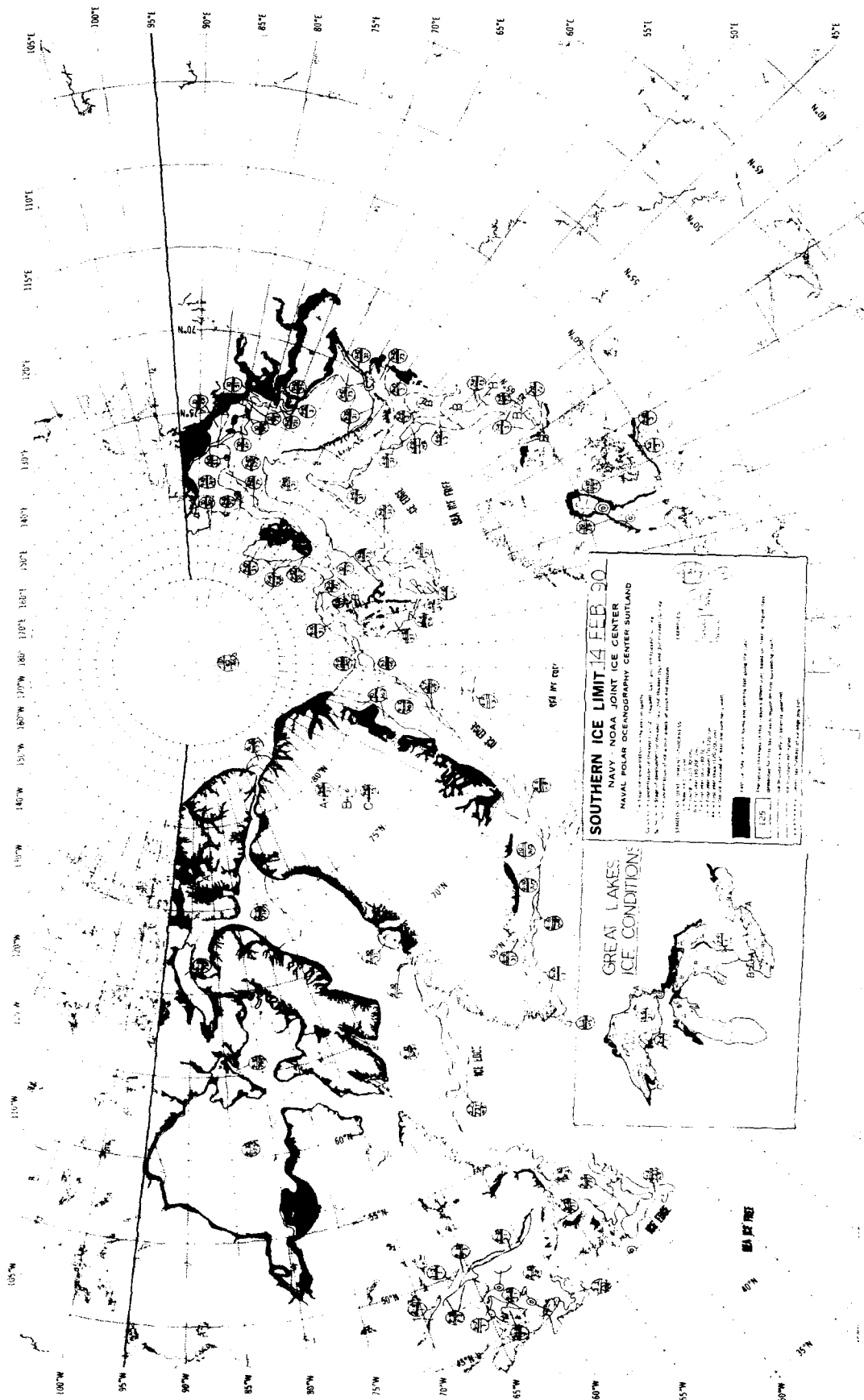
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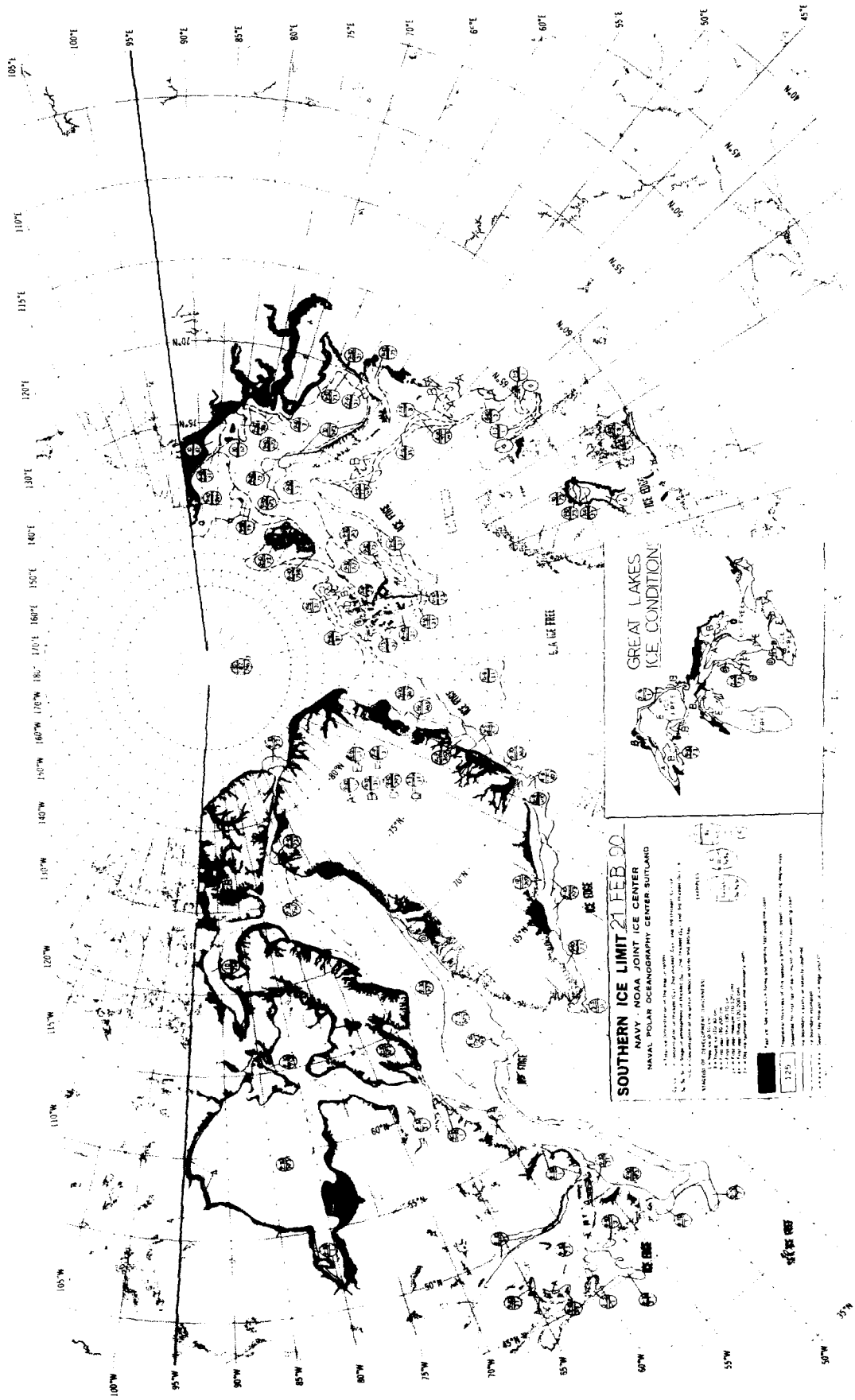
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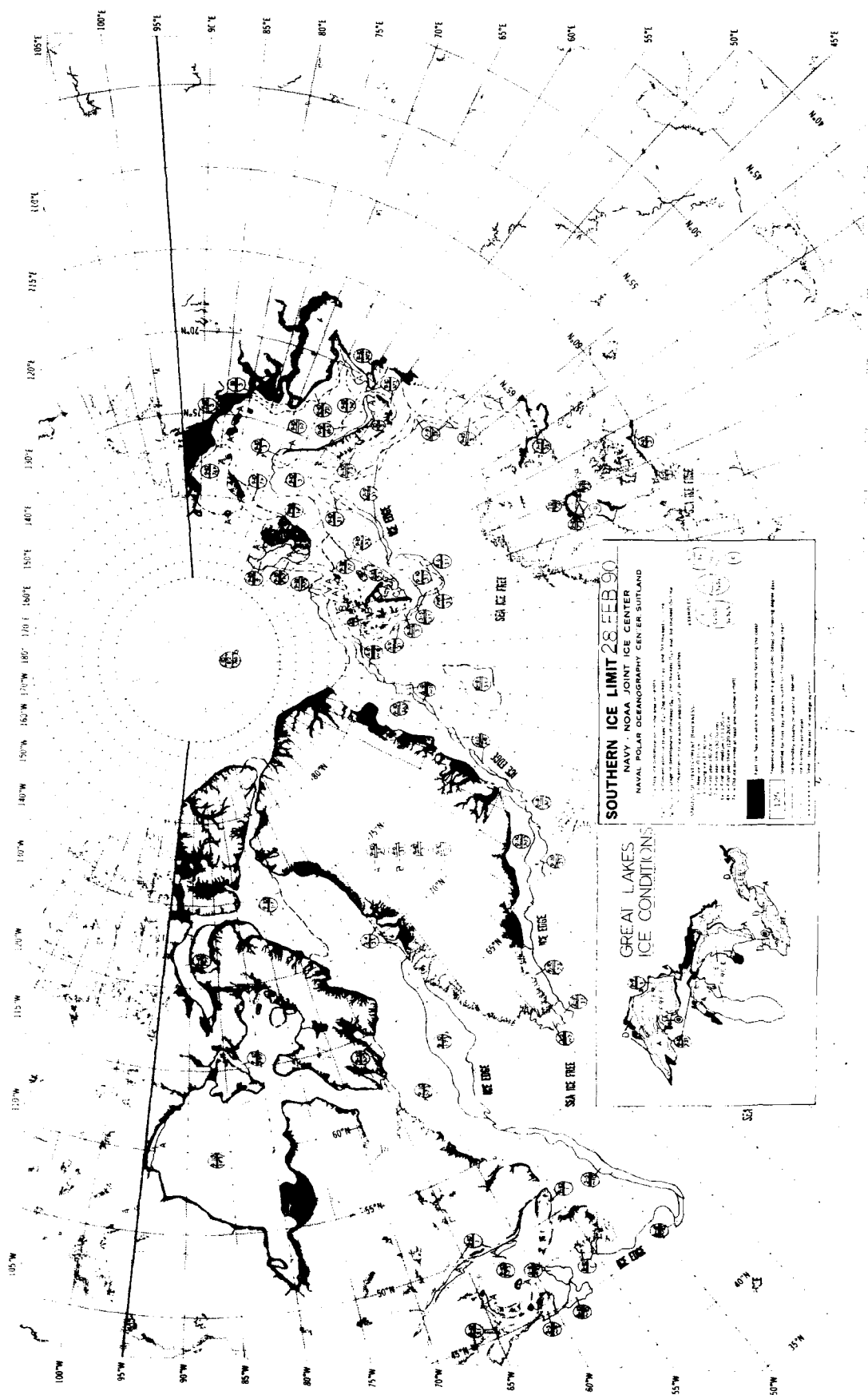
10. The map is not to be used for any other purpose without the written permission of the Navy.

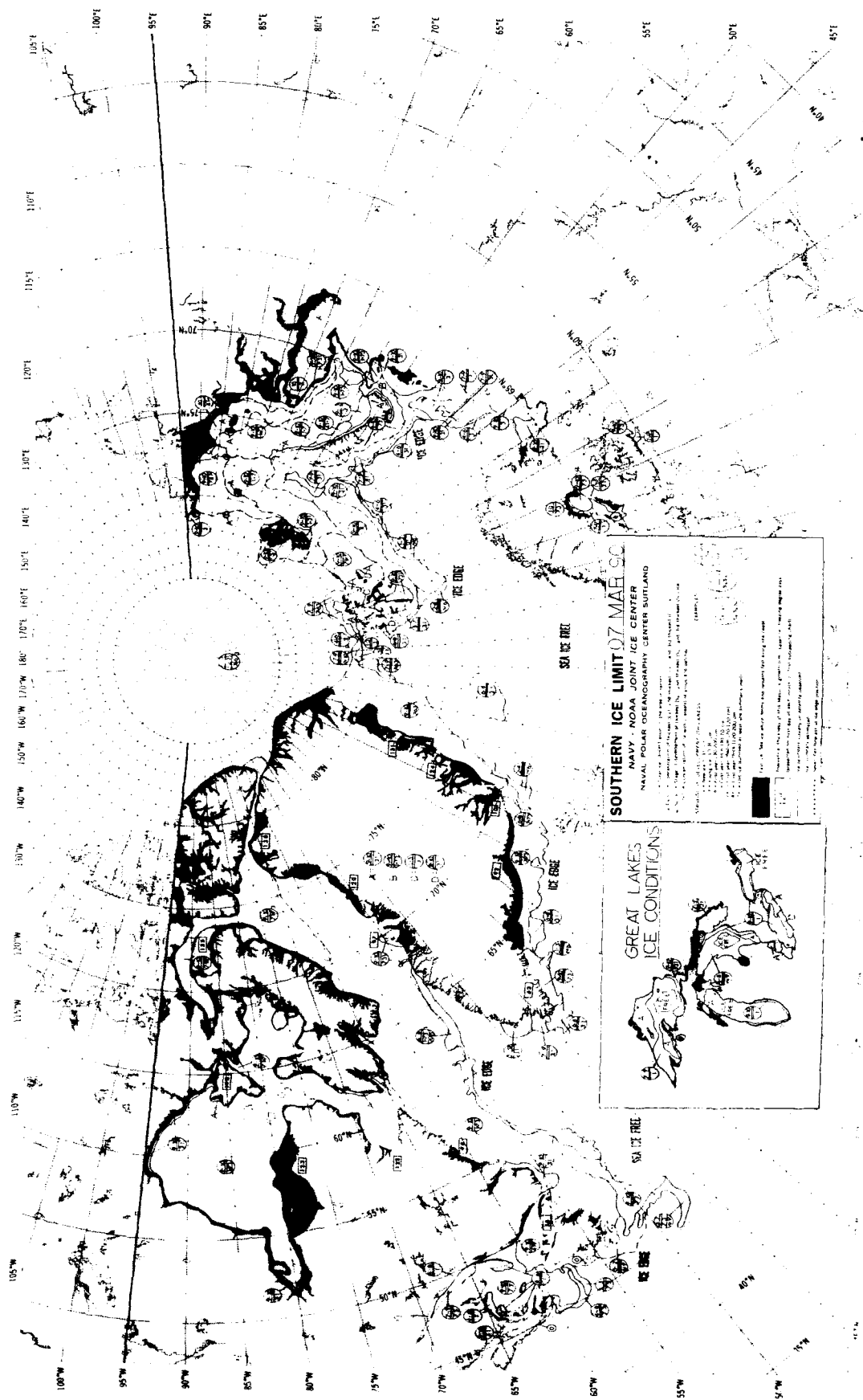


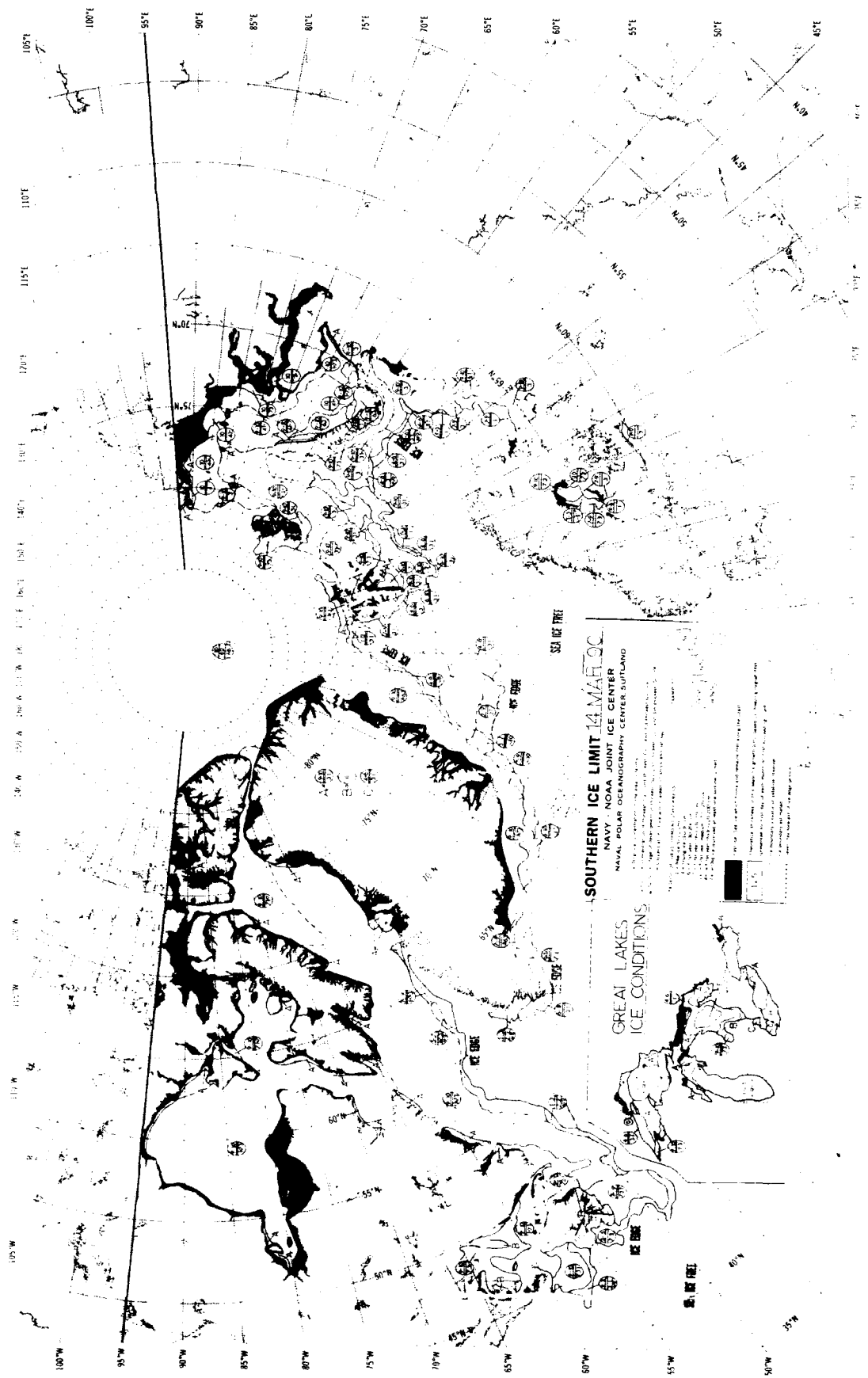








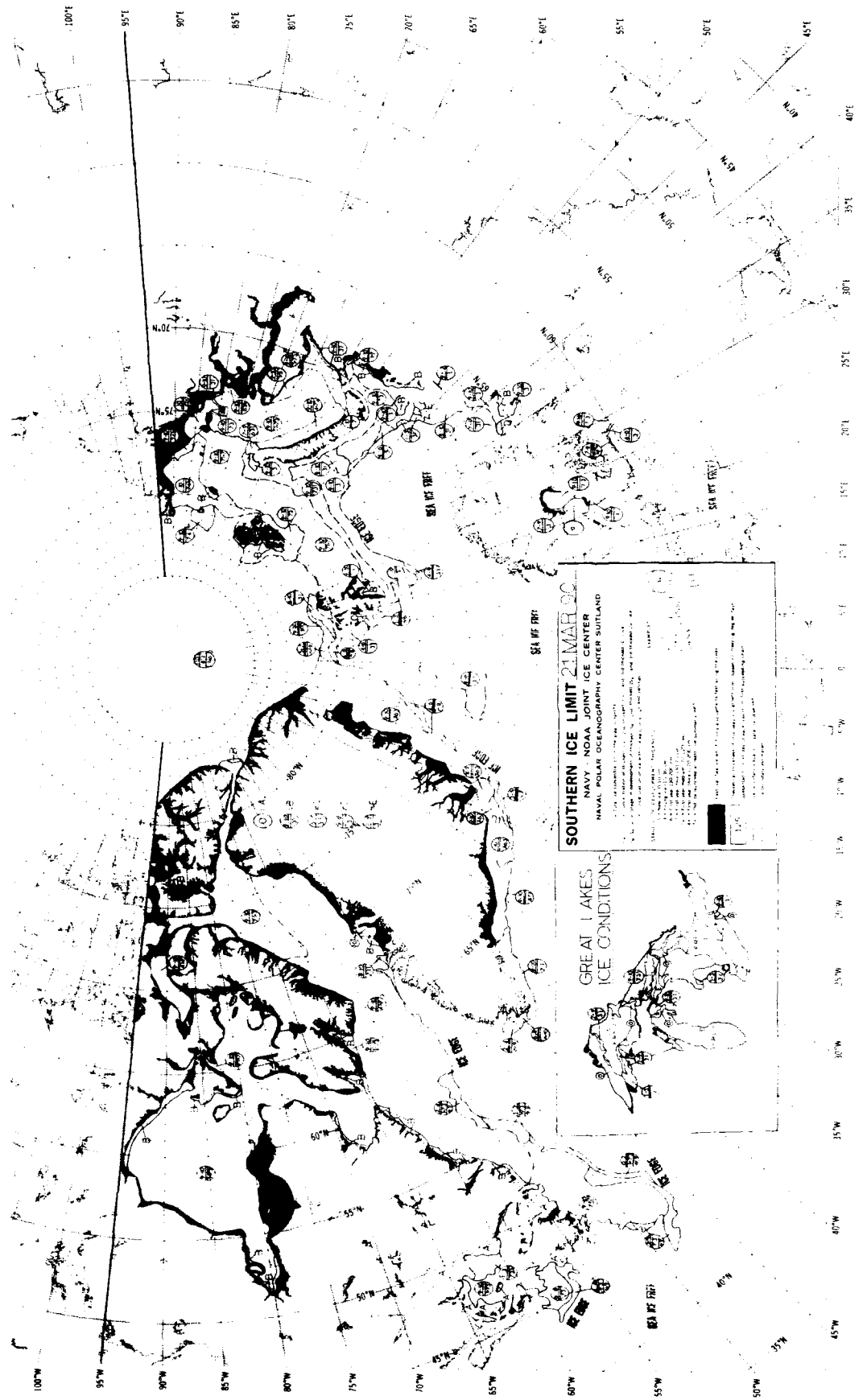


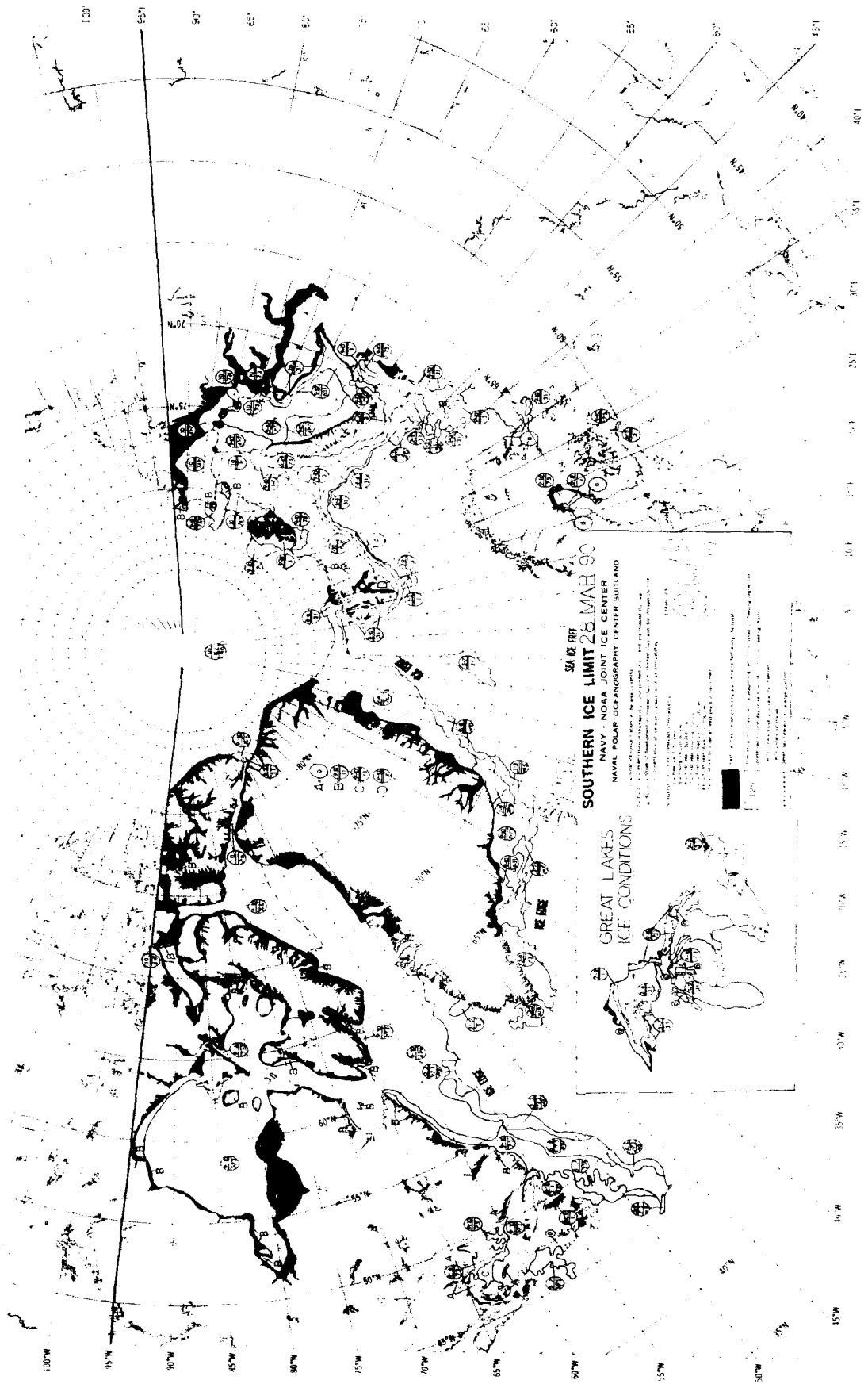


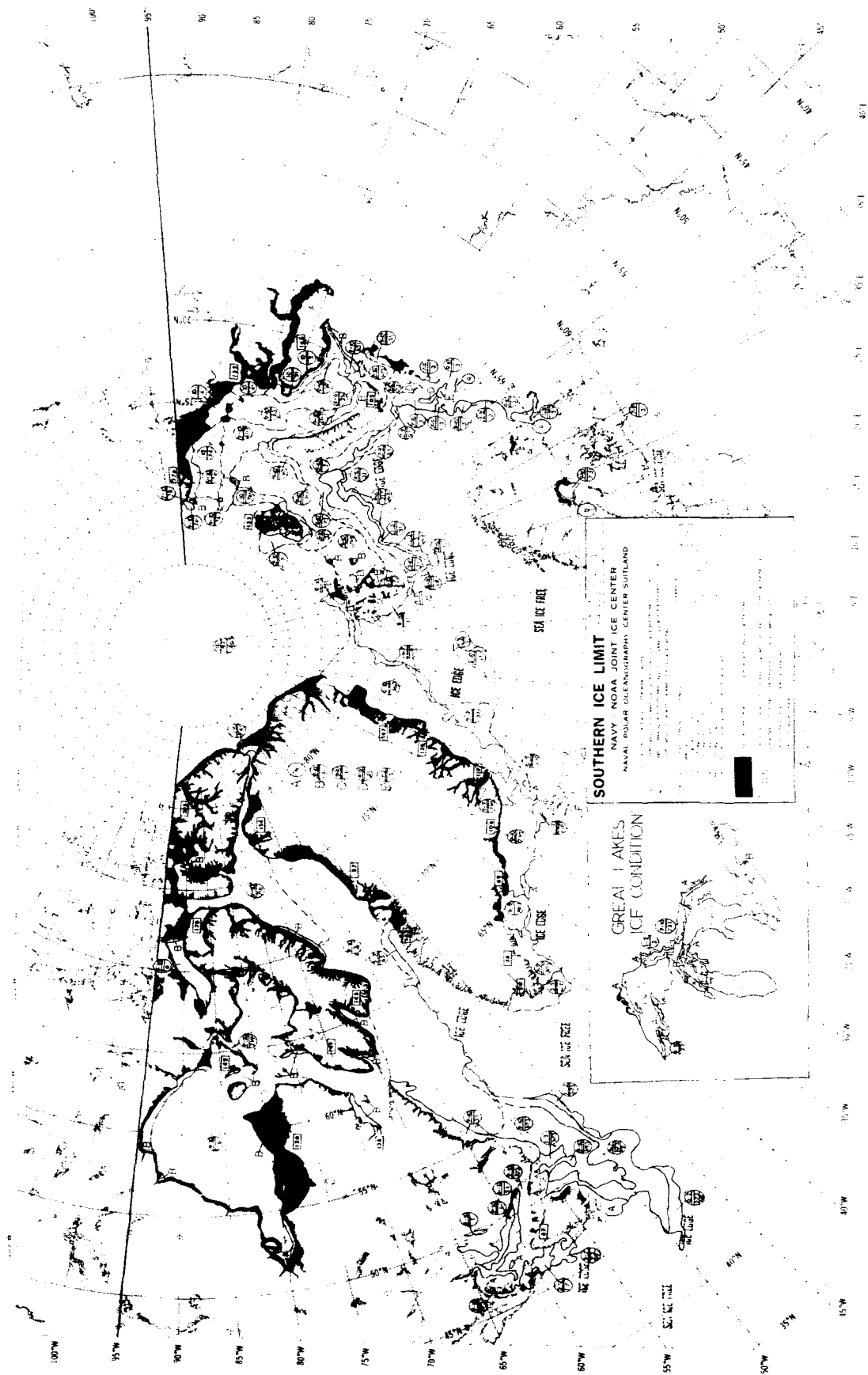
SOUTHERN ICE LIMIT 14 MAR 60
NAVY - NOAA JOINT ICE CENTER
NAVAL POLAR OCEANOGRAPHY CENTER SUTLAND

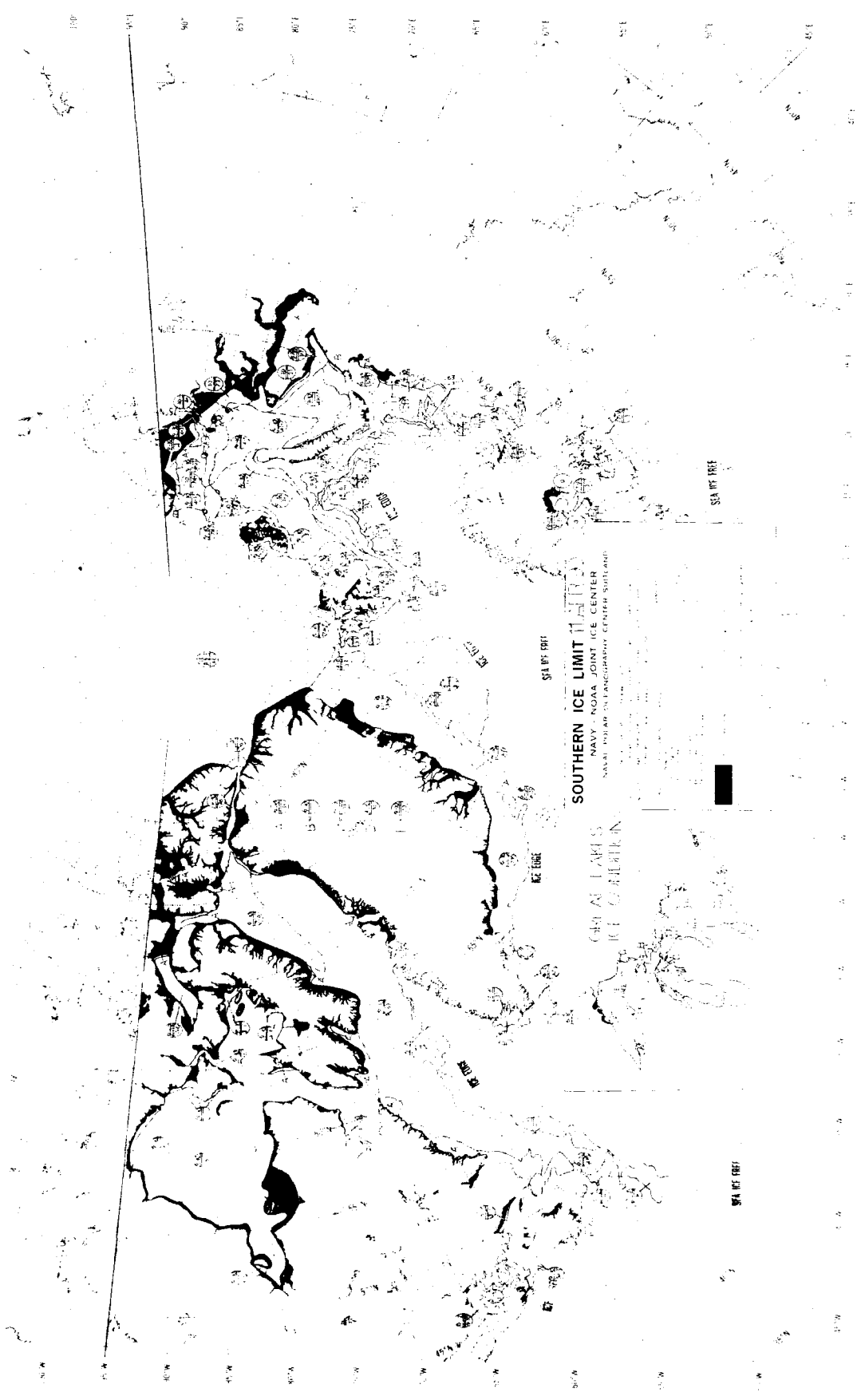
**GREAT LAKES
ICE CONDITIONS**

| Symbol | Description |
|----------|--------------------------|
| (Symbol) | Ice Limit |
| (Symbol) | Ice Edge |
| (Symbol) | Ice Type |
| (Symbol) | Ice Thickness |
| (Symbol) | Ice Age |
| (Symbol) | Ice Direction |
| (Symbol) | Ice Velocity |
| (Symbol) | Ice Pressure |
| (Symbol) | Ice Temperature |
| (Symbol) | Ice Salinity |
| (Symbol) | Ice Density |
| (Symbol) | Ice Viscosity |
| (Symbol) | Ice Elasticity |
| (Symbol) | Ice Compressibility |
| (Symbol) | Ice Thermal Conductivity |
| (Symbol) | Ice Specific Heat |
| (Symbol) | Ice Latent Heat |
| (Symbol) | Ice Melting Point |
| (Symbol) | Ice Freezing Point |
| (Symbol) | Ice Boiling Point |
| (Symbol) | Ice Sublimation Point |
| (Symbol) | Ice Condensation Point |
| (Symbol) | Ice Evaporation Point |
| (Symbol) | Ice Precipitation Point |
| (Symbol) | Ice Accumulation Point |
| (Symbol) | Ice Erosion Point |
| (Symbol) | Ice Deposition Point |
| (Symbol) | Ice Transport Point |
| (Symbol) | Ice Storage Point |
| (Symbol) | Ice Release Point |
| (Symbol) | Ice Capture Point |
| (Symbol) | Ice Escape Point |
| (Symbol) | Ice Entrapment Point |
| (Symbol) | Ice Liberation Point |
| (Symbol) | Ice Confinement Point |
| (Symbol) | Ice Release Point |
| (Symbol) | Ice Capture Point |
| (Symbol) | Ice Escape Point |
| (Symbol) | Ice Entrapment Point |
| (Symbol) | Ice Liberation Point |
| (Symbol) | Ice Confinement Point |









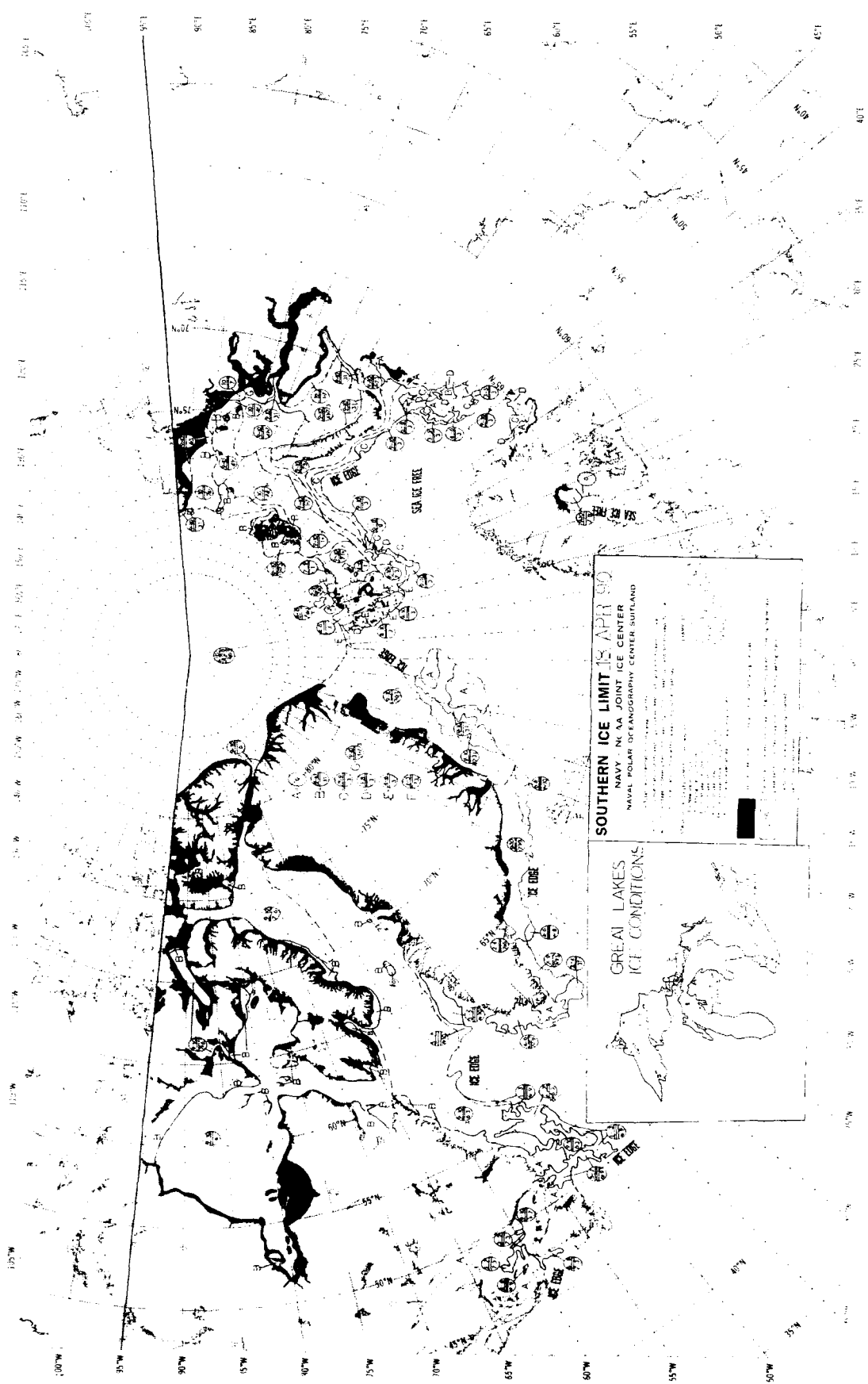
SEA 105 1001

SOUTHERN ICE LIMIT
NAVY - NOAA JOINT ICE CENTER
NAVAL POLAR IN FANGUARDY CENTER SOUTLAND

CHAL LAYS
ICE CENTER

SEA 105 1001

SEA 105 1001

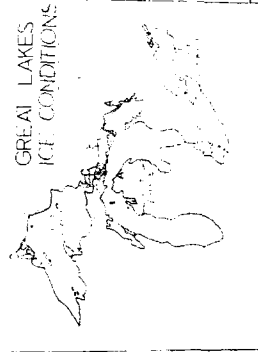


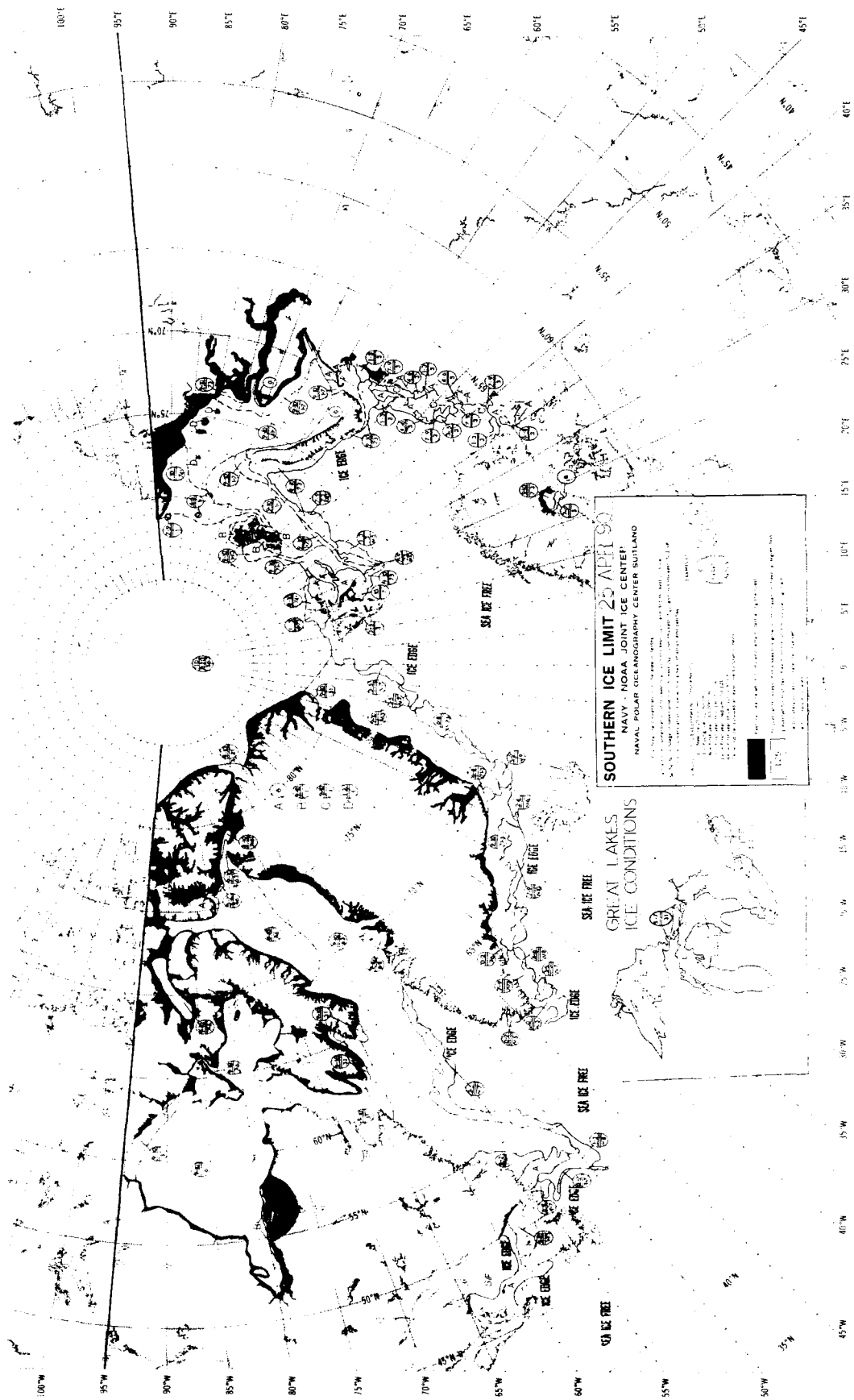
SOUTHERN ICE LIMIT 15 APR 80

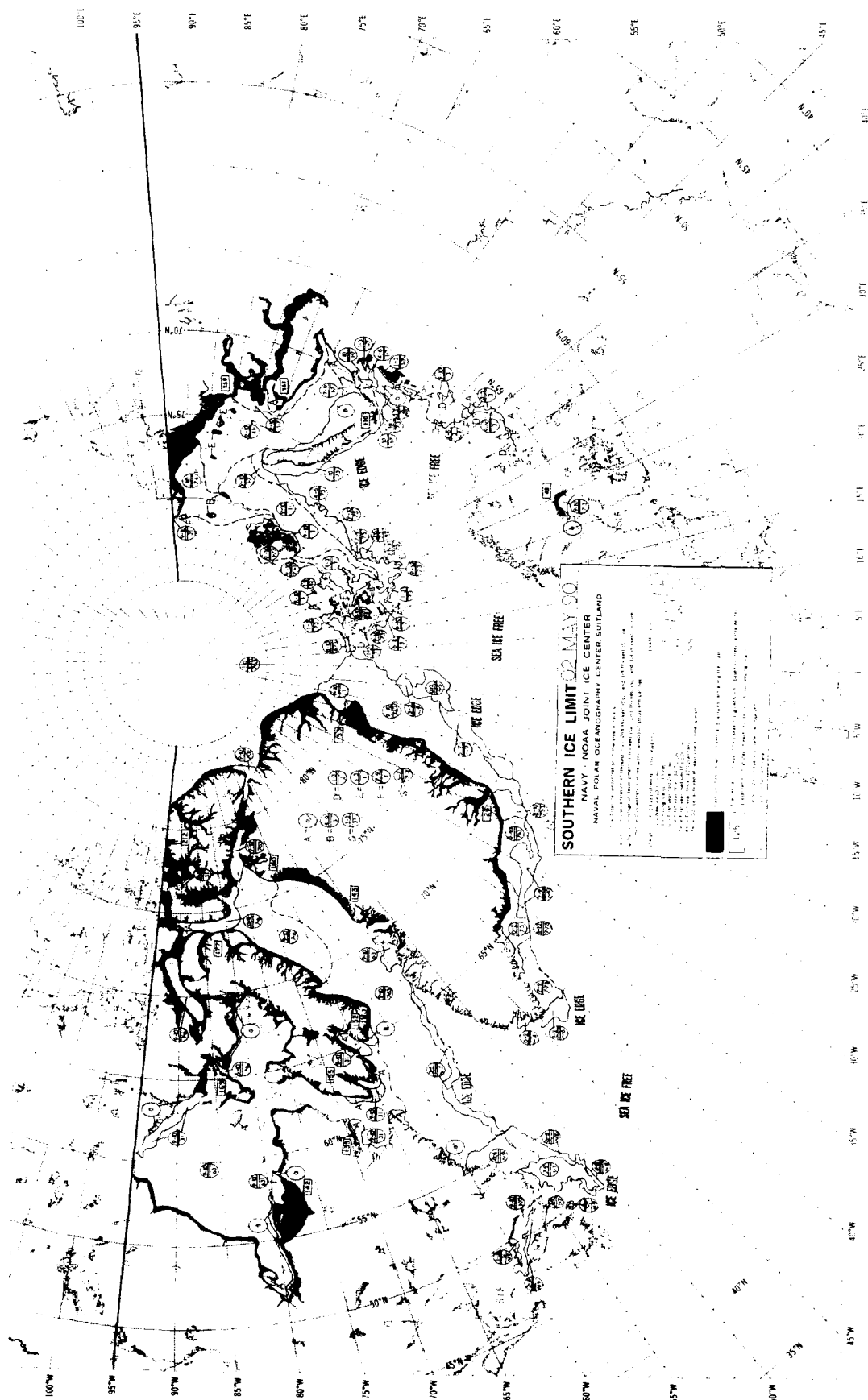
NAVY - NC AA JOINT ICE CENTER

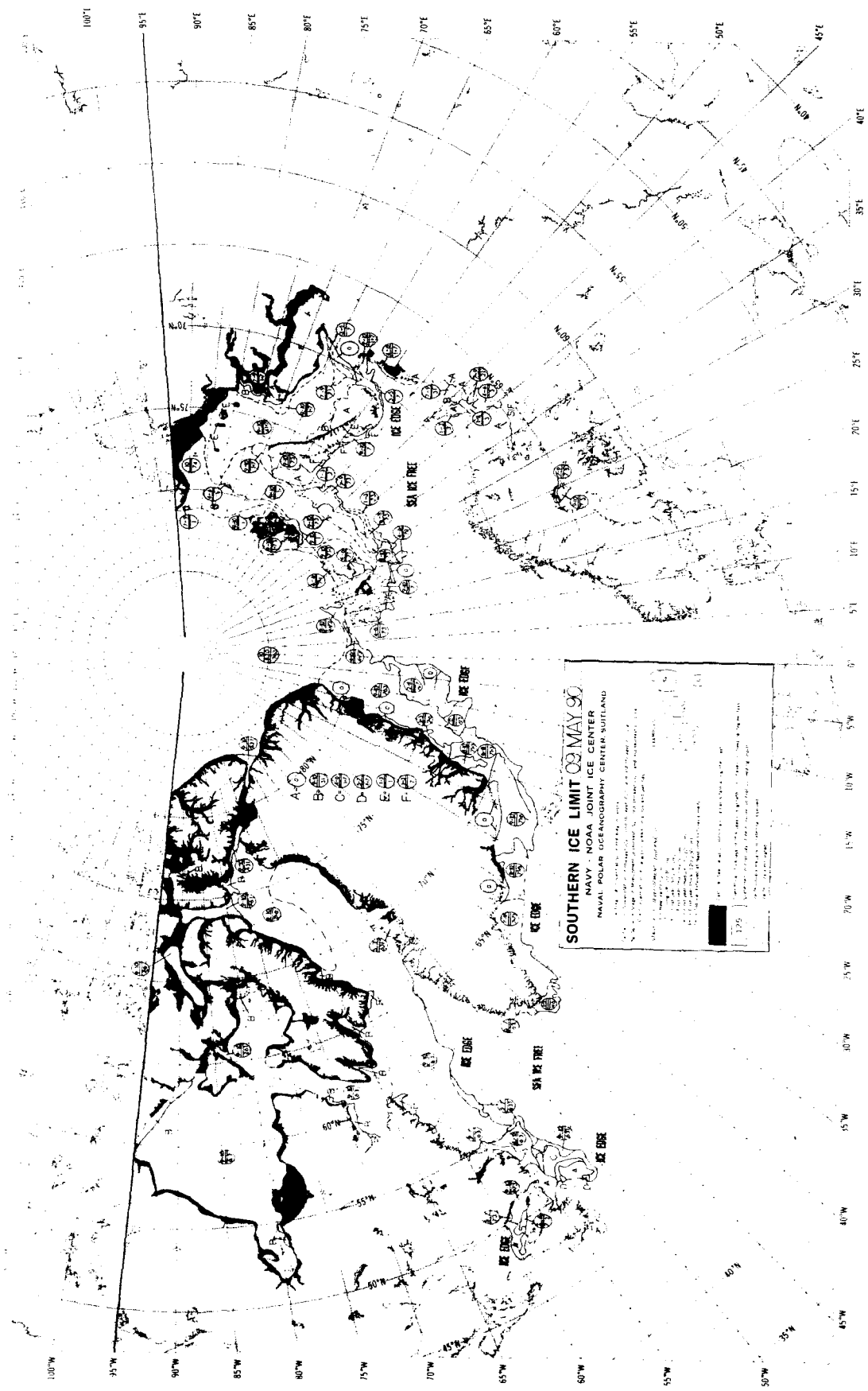
NAVAL POLAR OCEANOGRAPHY CENTER SUITLAND

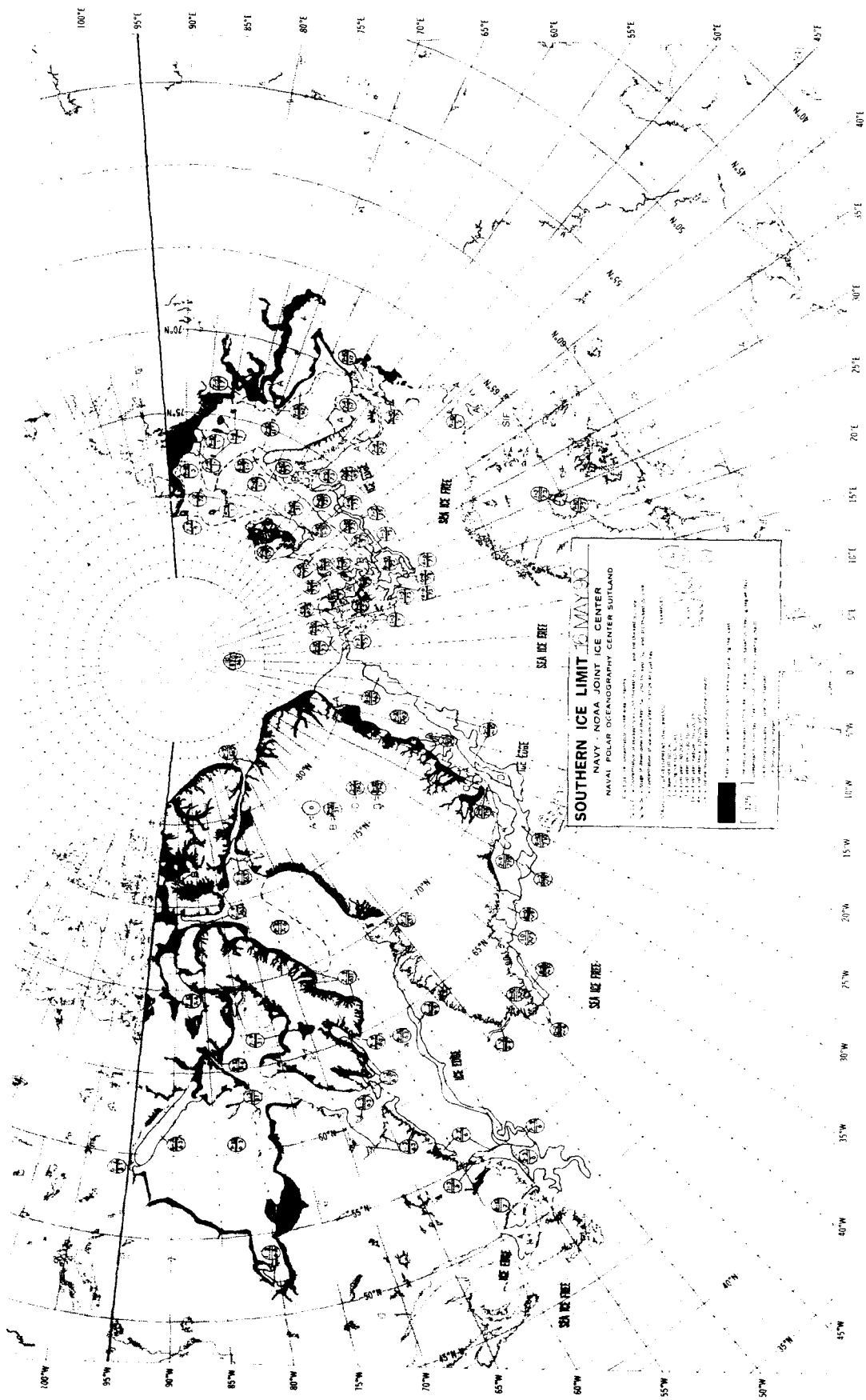
GREAT LAKES
ICE CONDITIONS

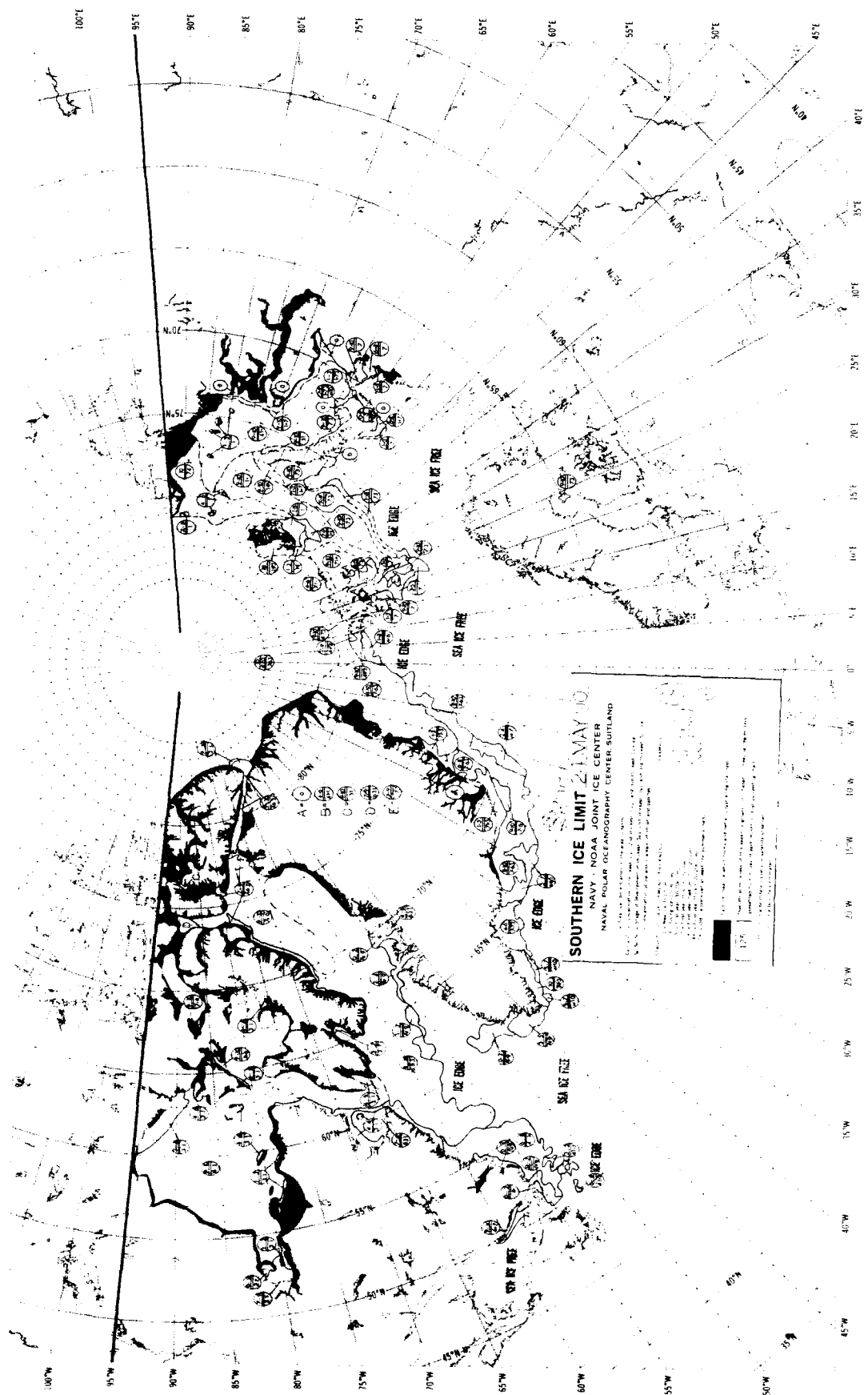


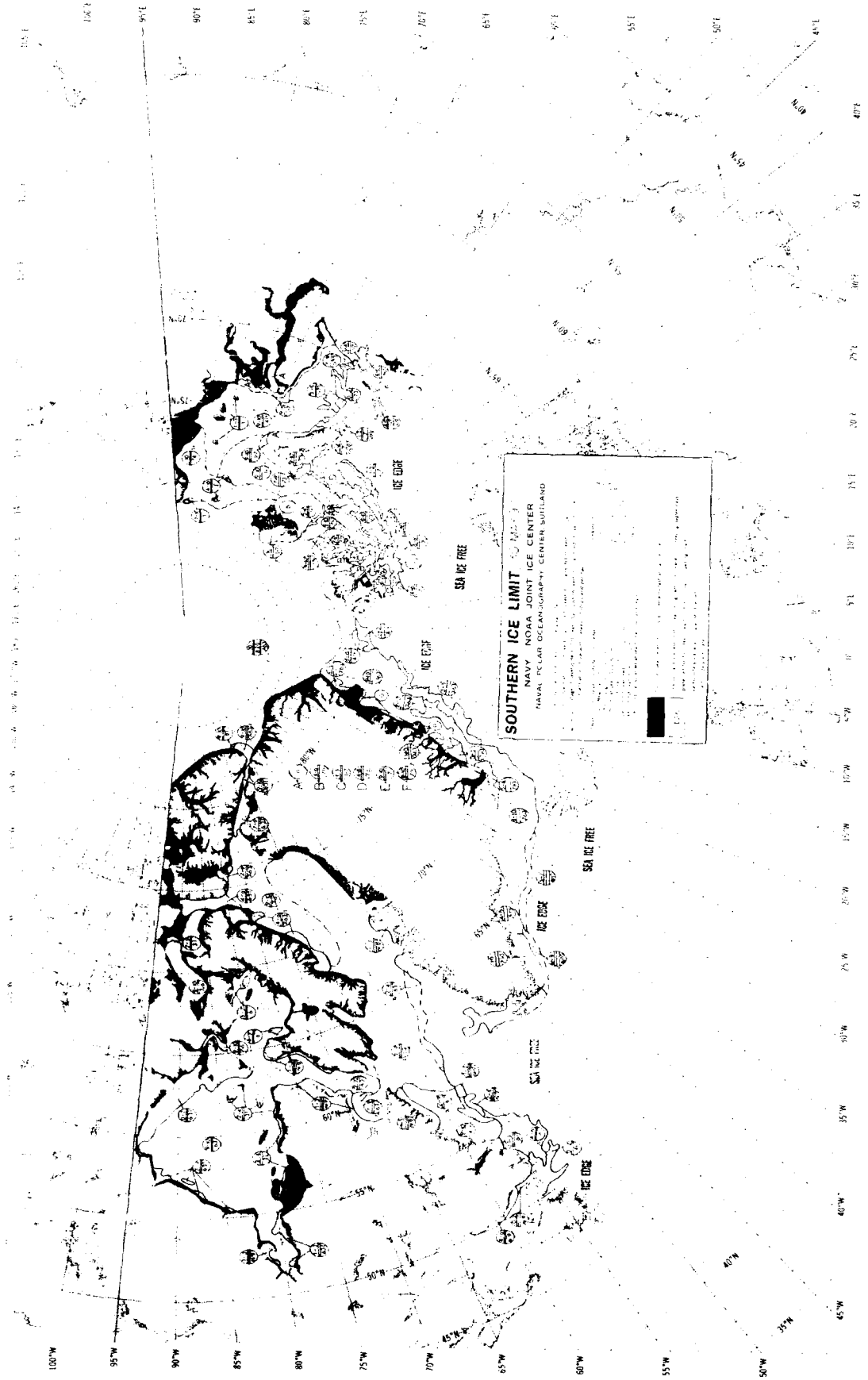


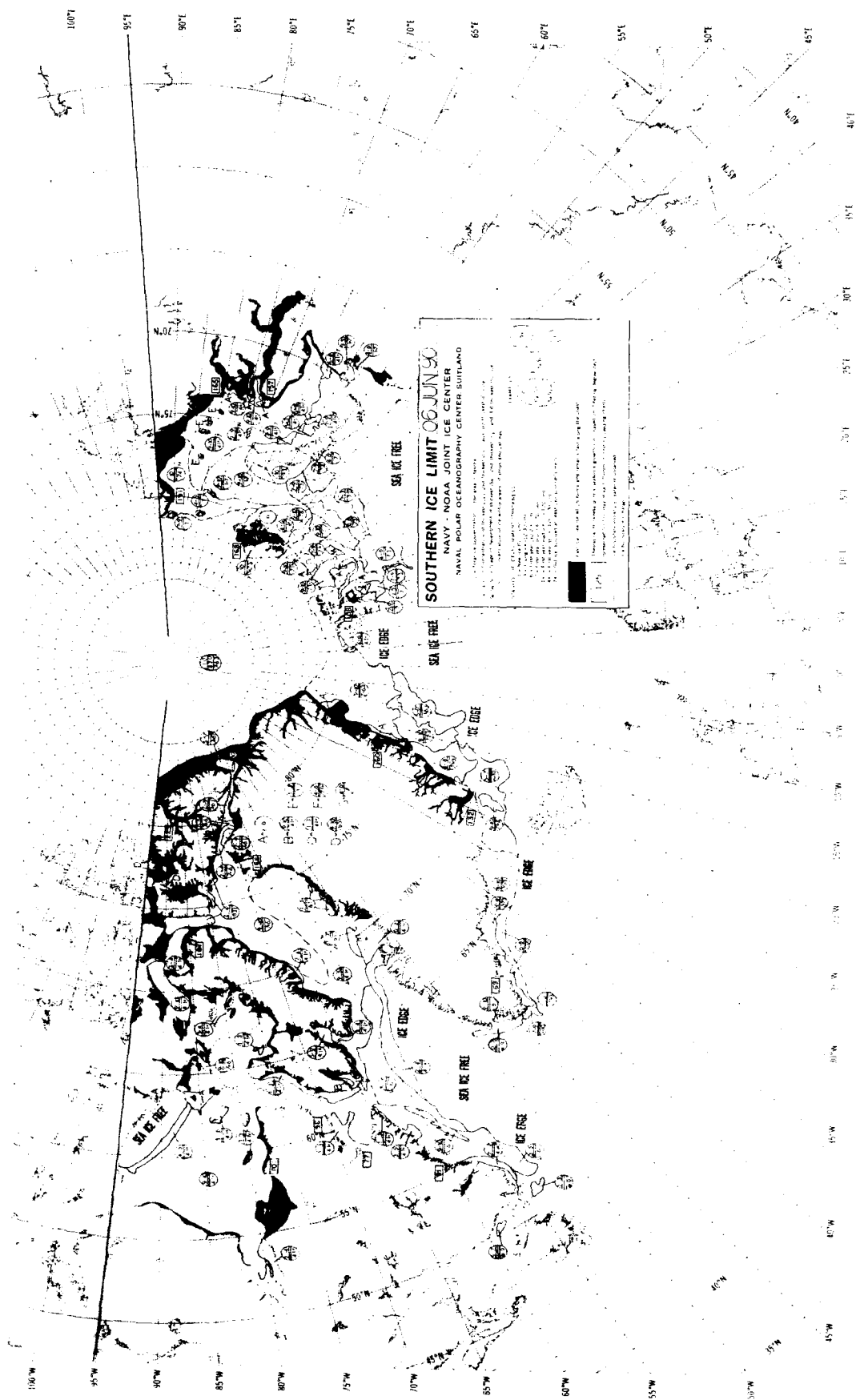


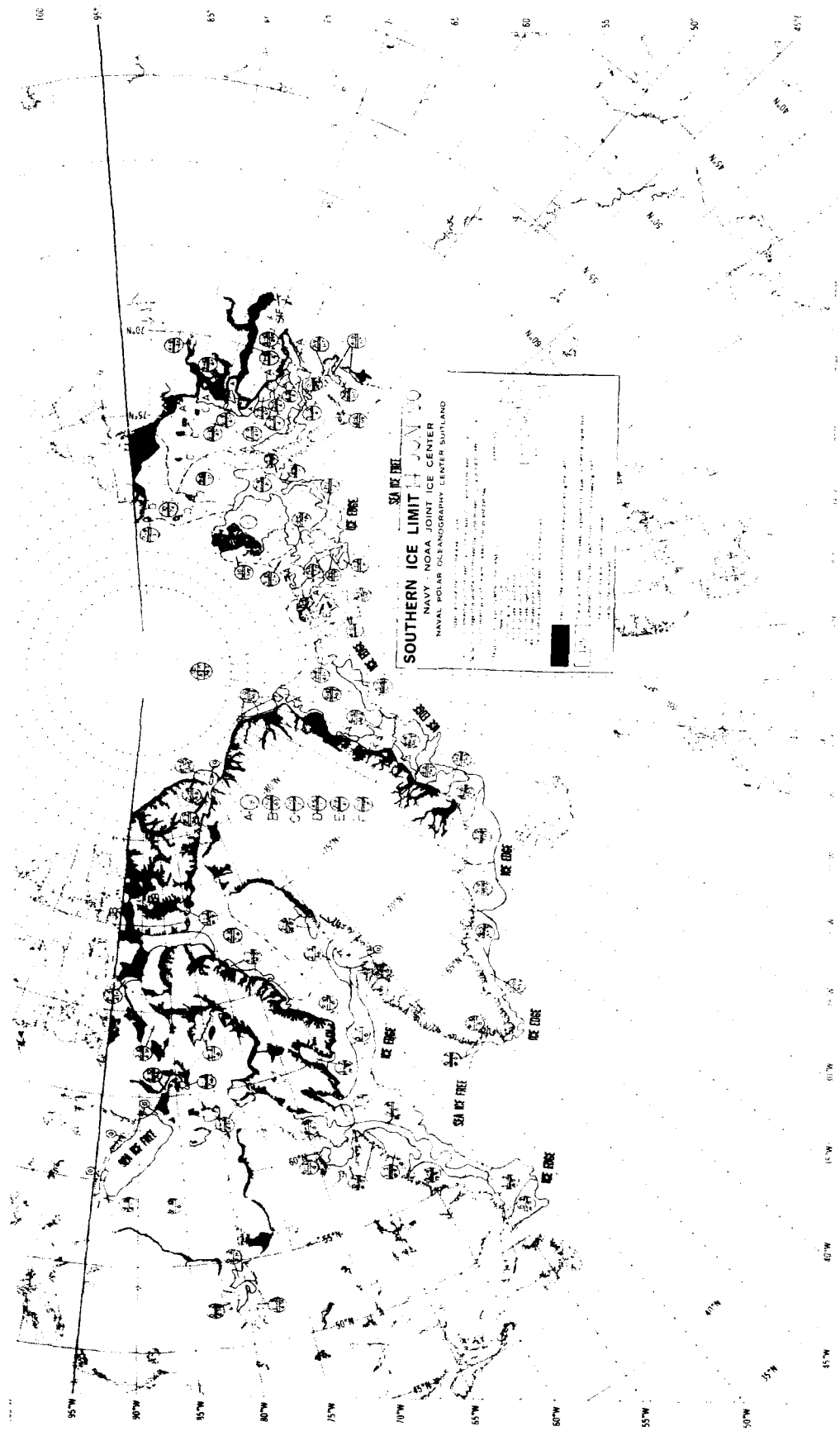


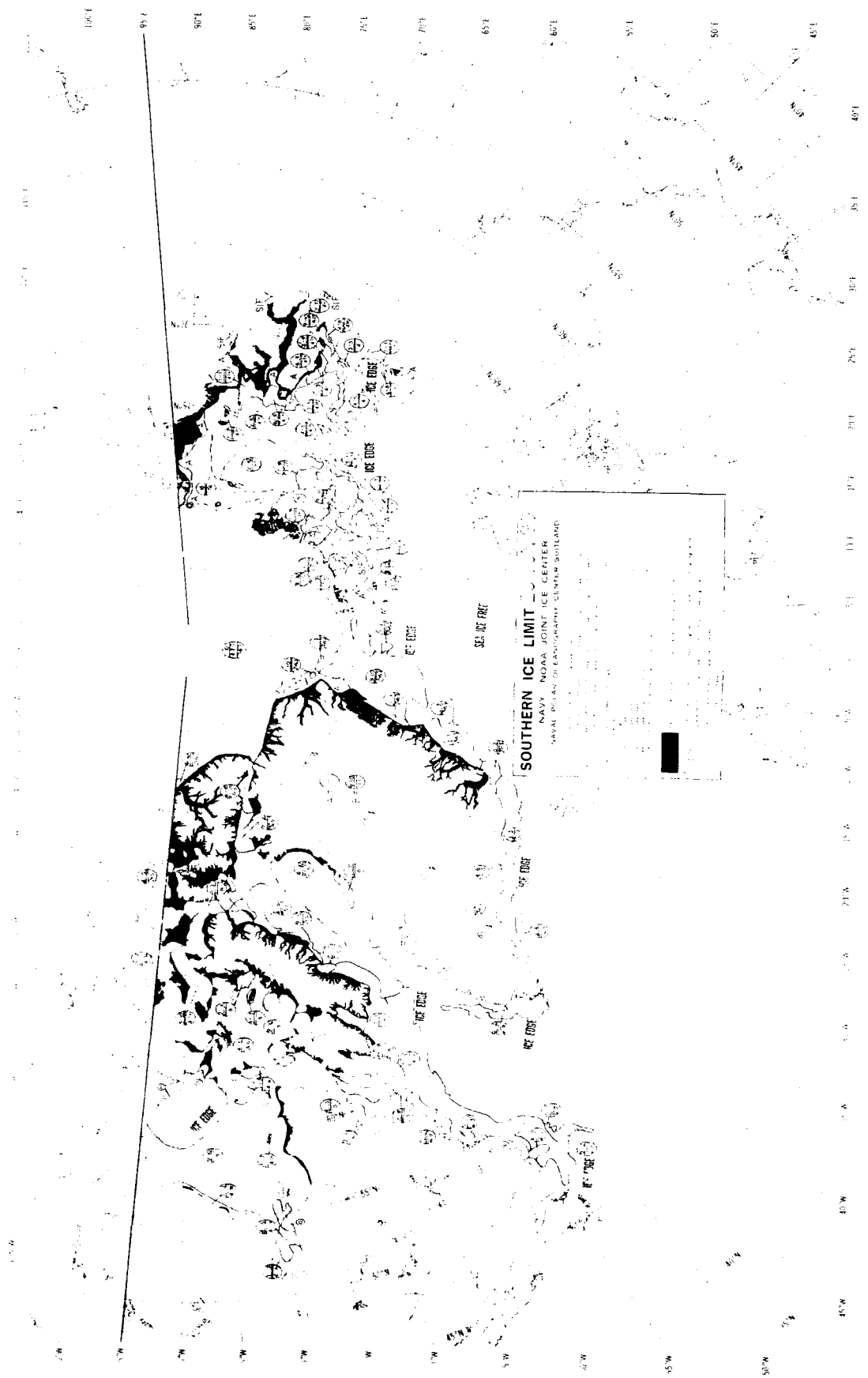








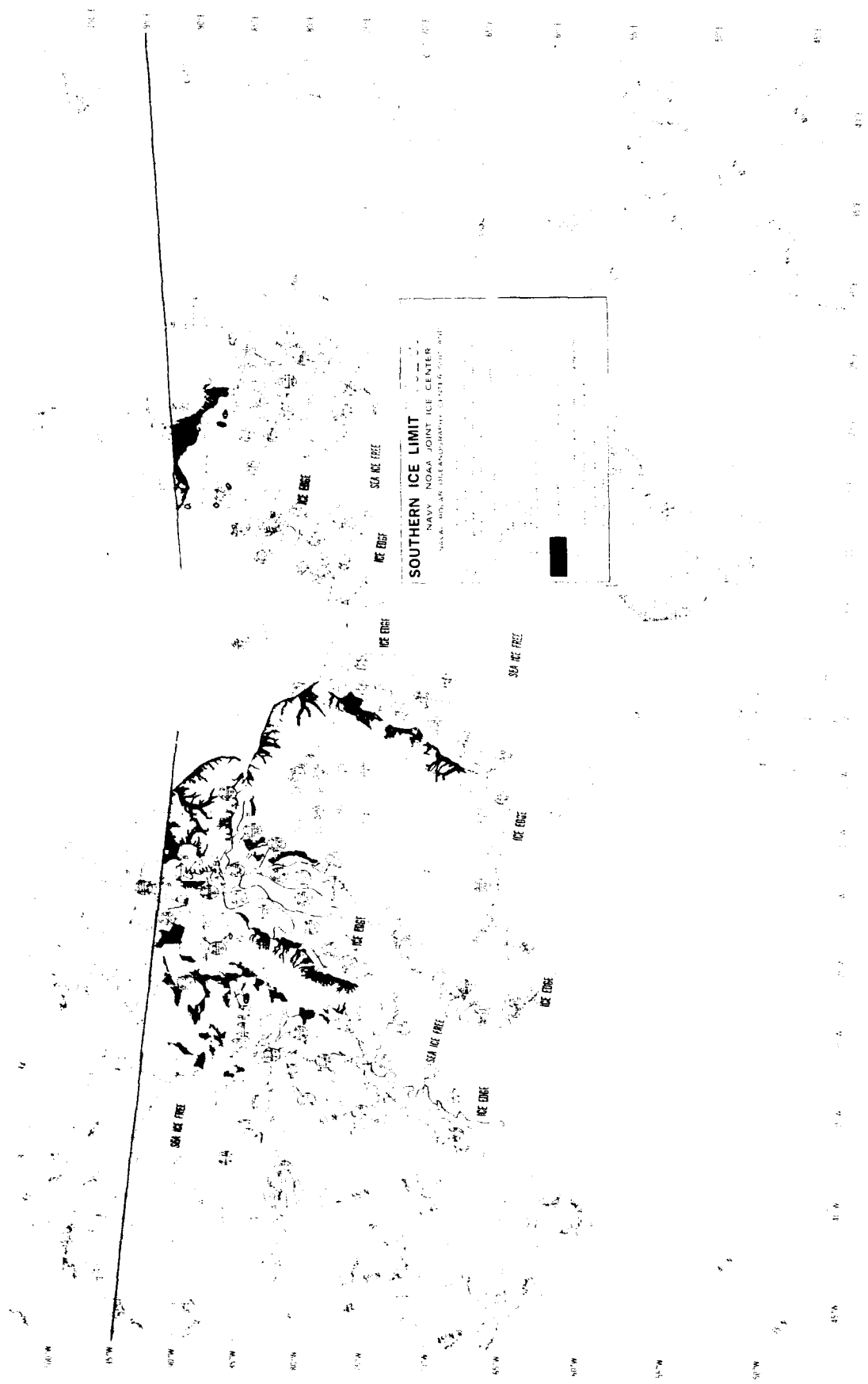


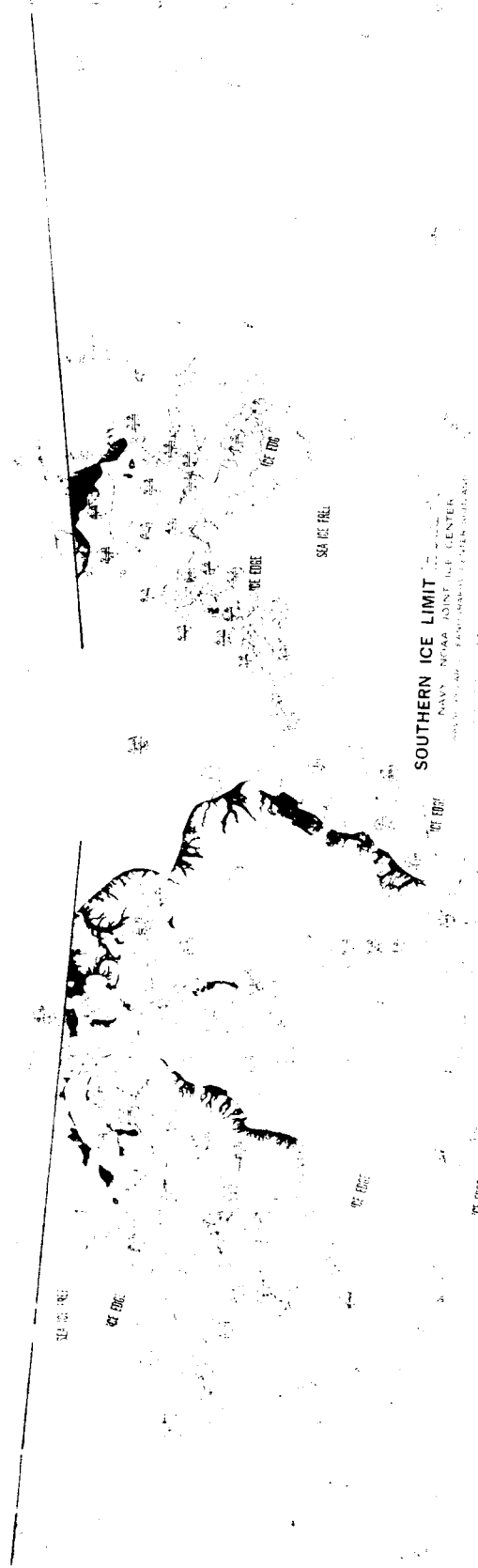


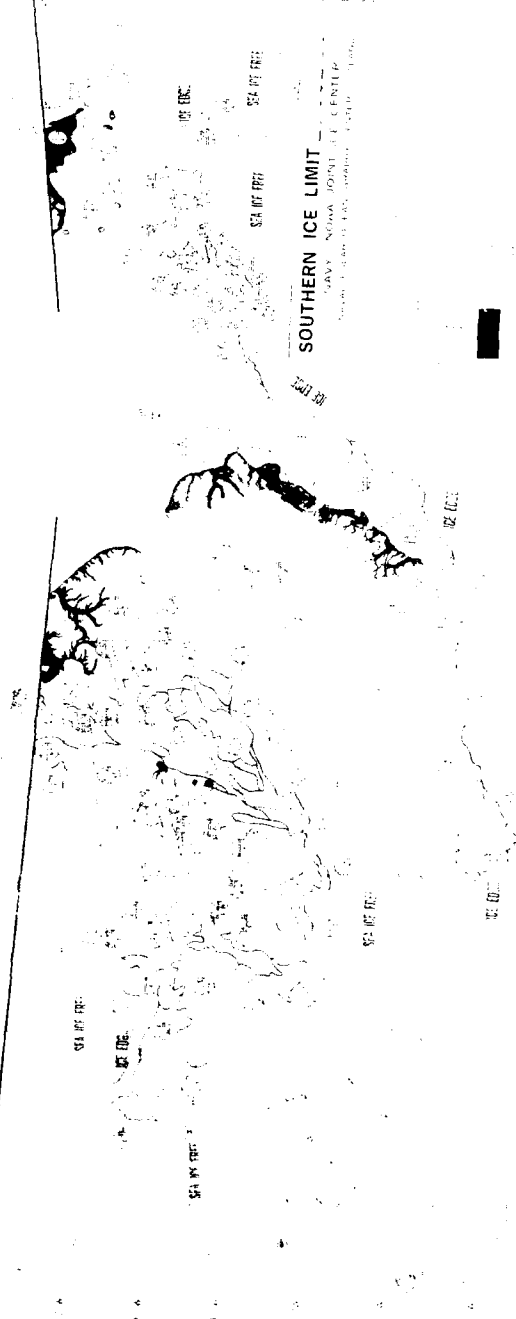
SOUTHERN ICE LIMIT -
NAVY NOAA JOINT ICE CENTER
NAVAL POLAR OR LANDGRAPHY CENTER OUTLAND



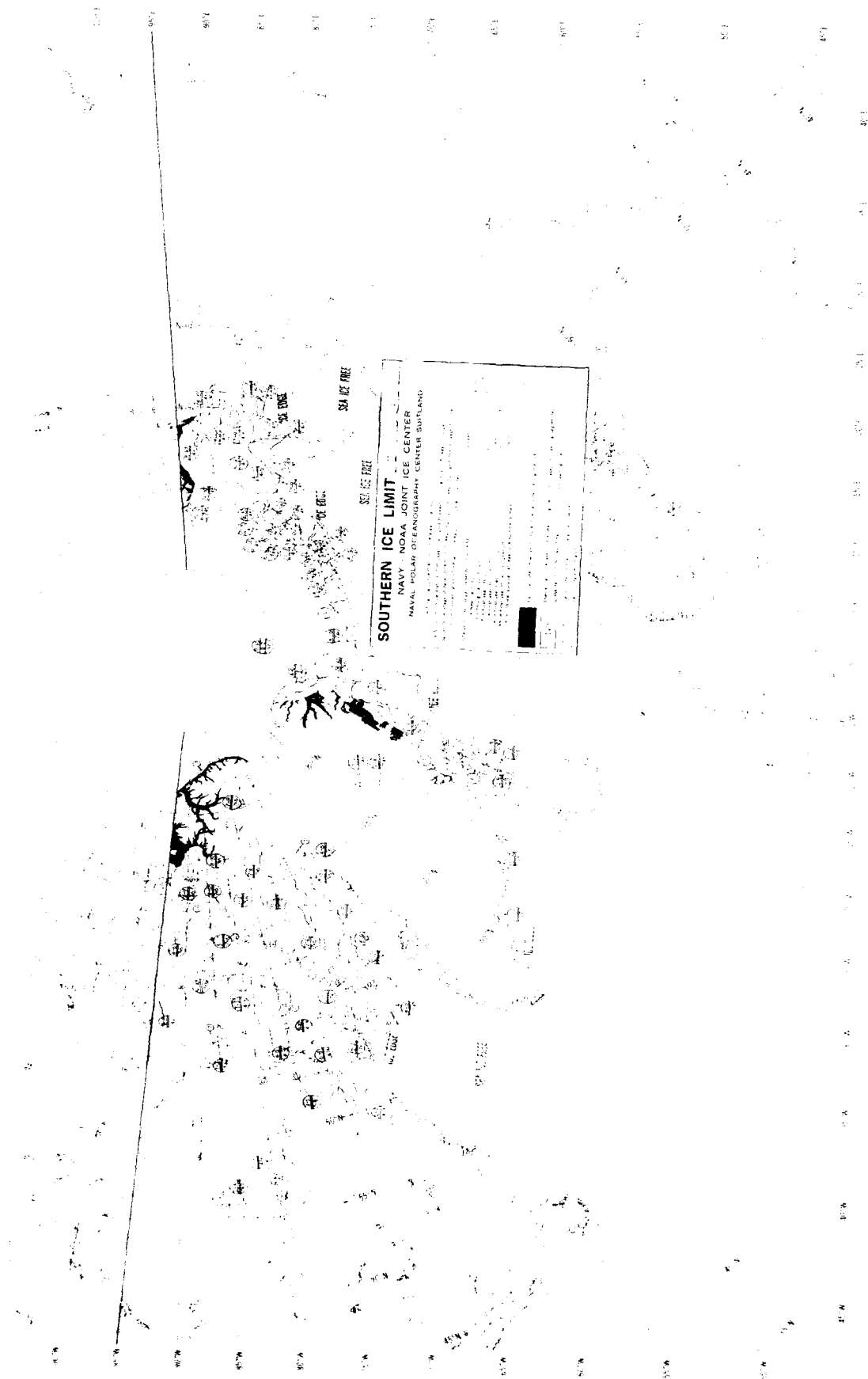


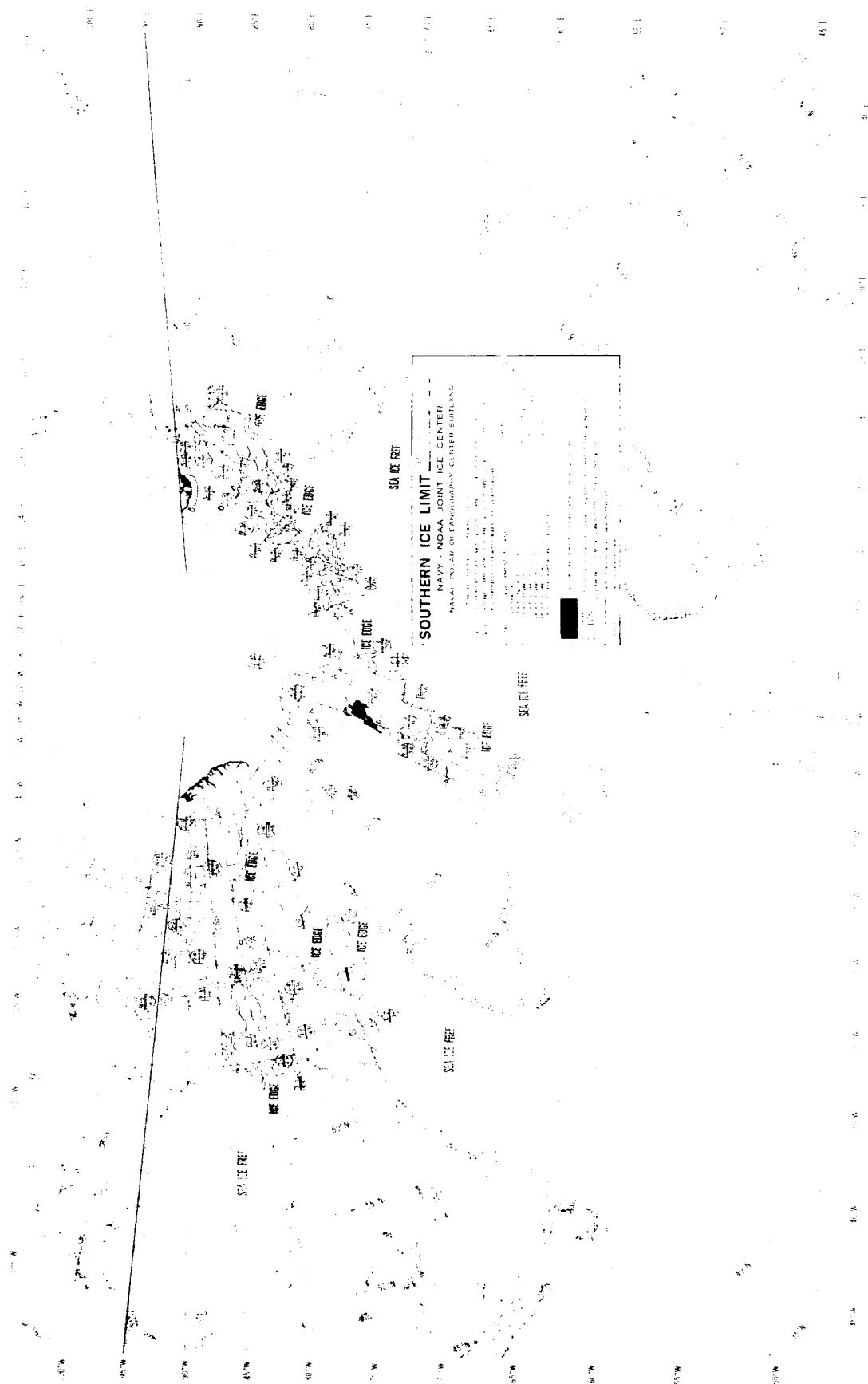


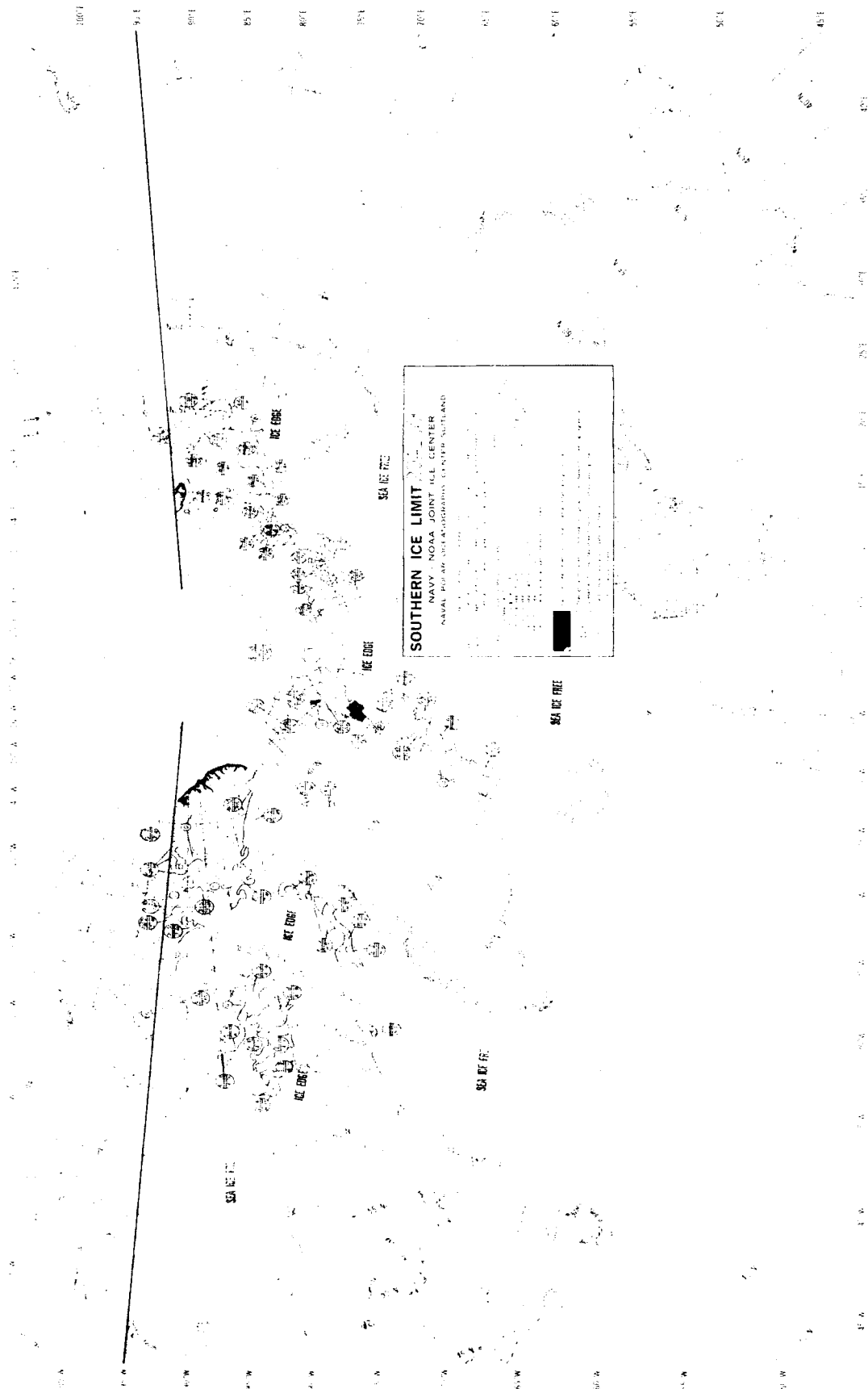








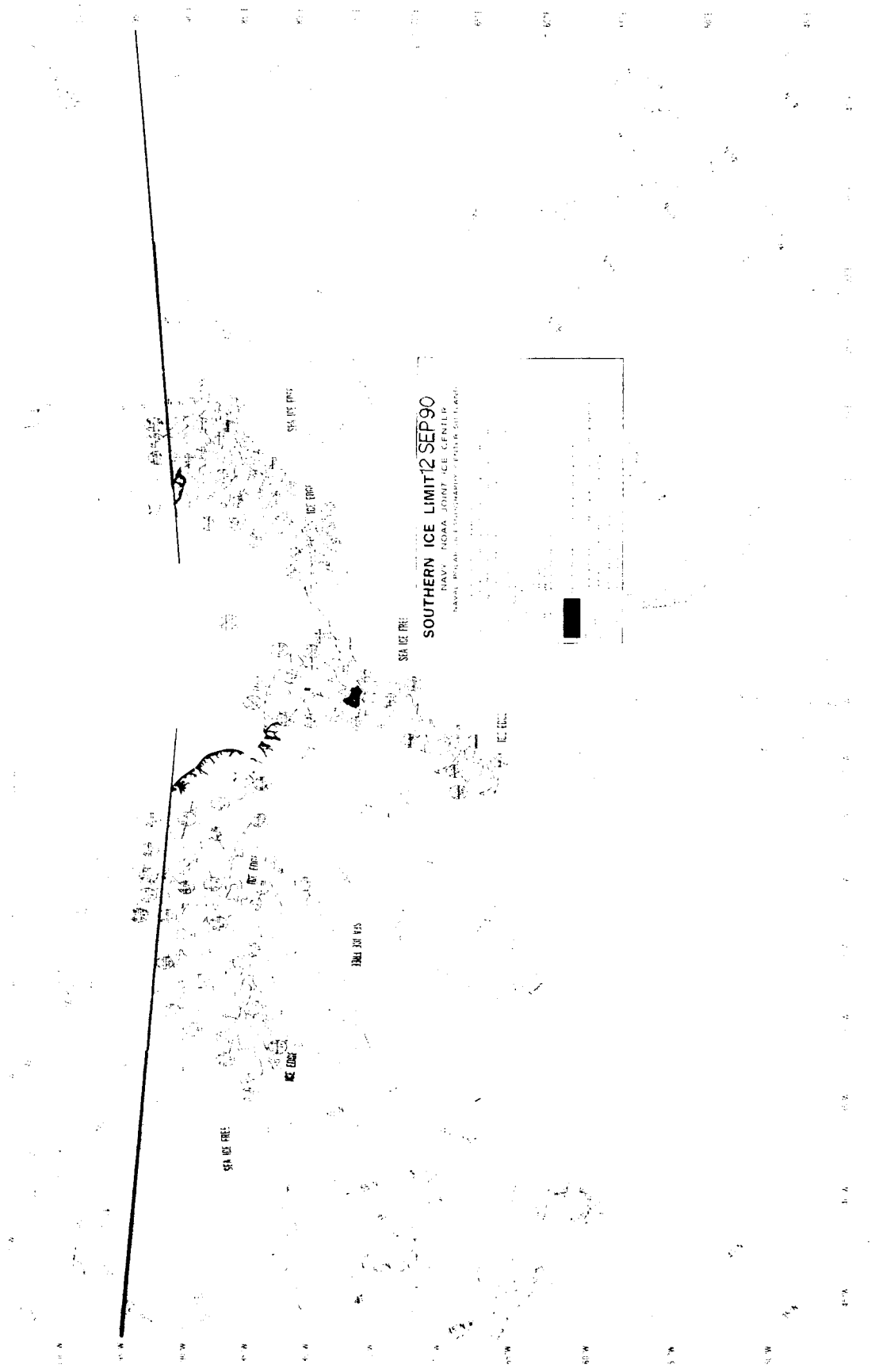




SOUTHERN ICE LIMIT
NAVY - NOAA JOINT ILL CENTER
NAVAL POLAR OPERATIONS CENTER, NANTUCKET, MA
[Redacted]

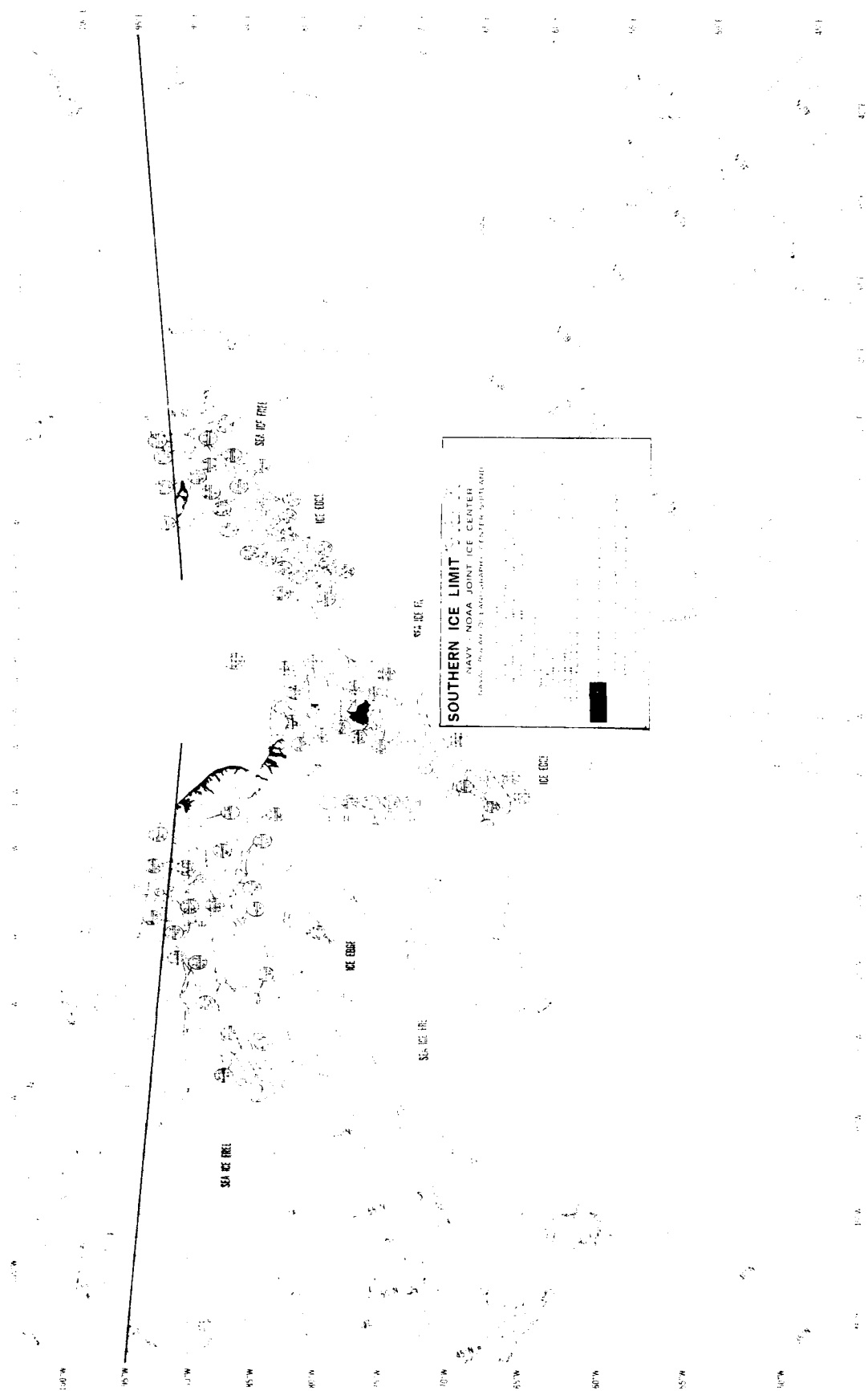


SOUTHERN ICE LIMIT
NAVY - NOAA JOINT ICE CENTER
NAVAL POLAR OCEANOGRAPHY CENTER SUTLAND



SOUTHERN ICE LIMIT 12 SEP 90

NAVY - NOAA JOINT ICE CENTER
NAVAL ROTARY ICE TRANSPORT CENTER SUTLAGE



SOUTHERN ICE LIMIT
NAVY - NOAA JOINT ICE CENTER
PACIFIC OCEAN - LANTANA - CENTER - 10°E

SOUTHERN ICE LIMIT

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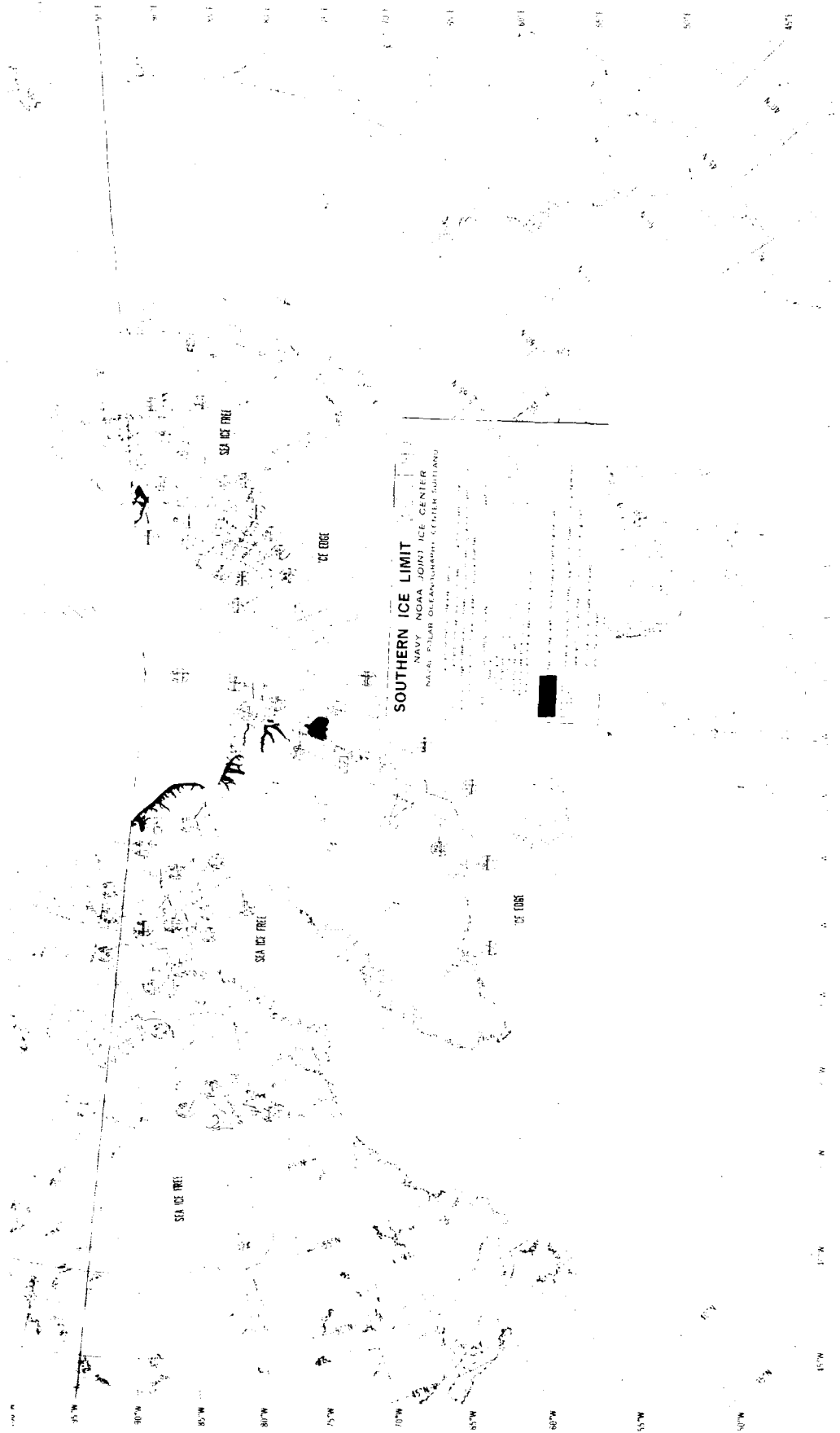
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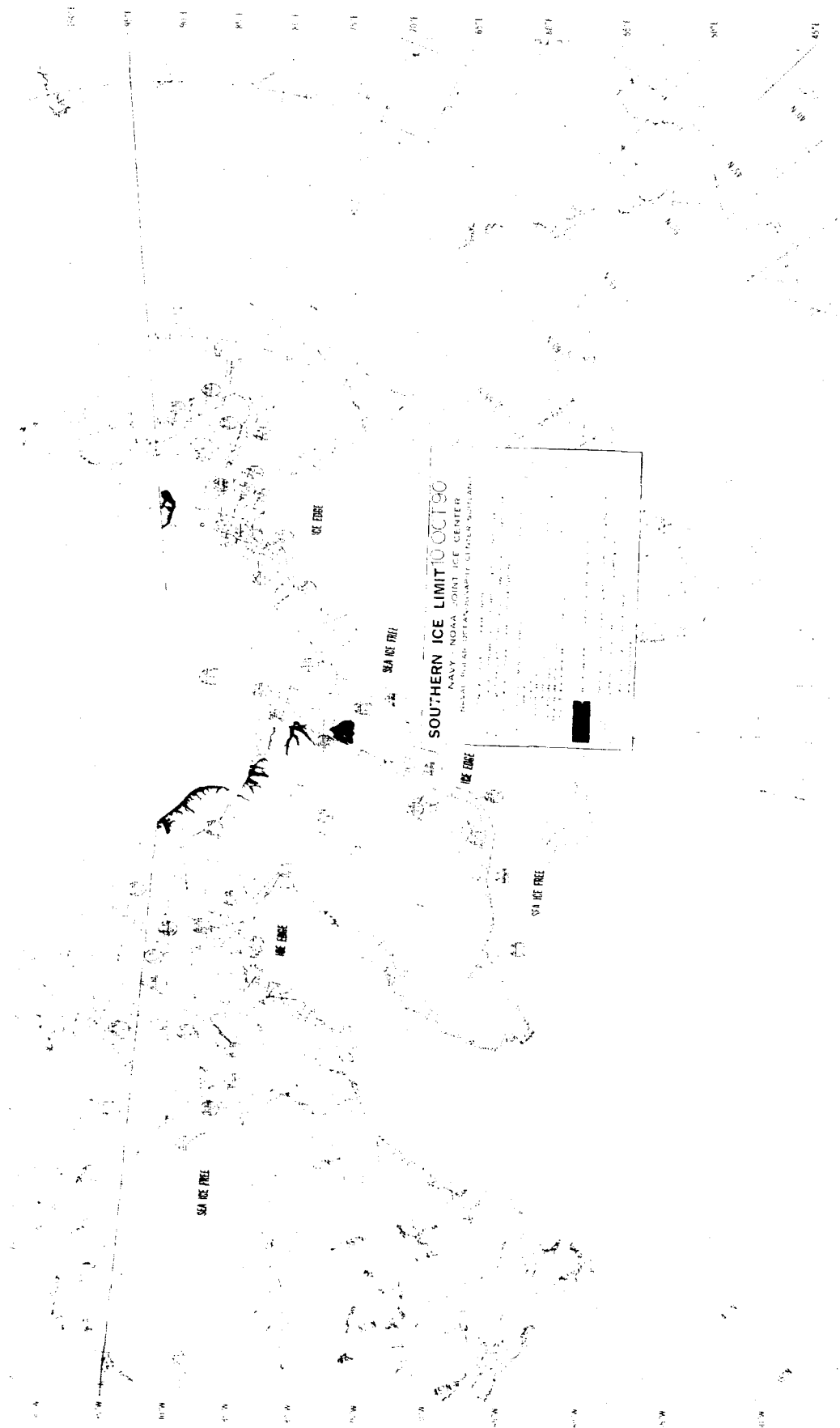
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SOUTHERN ICE LIMIT 10 OCT 90
NAVY - NOAA JOINT ICE CENTER
PACIFIC OCEAN SURVEILLANCE CENTER, WASHINGTON, D.C.

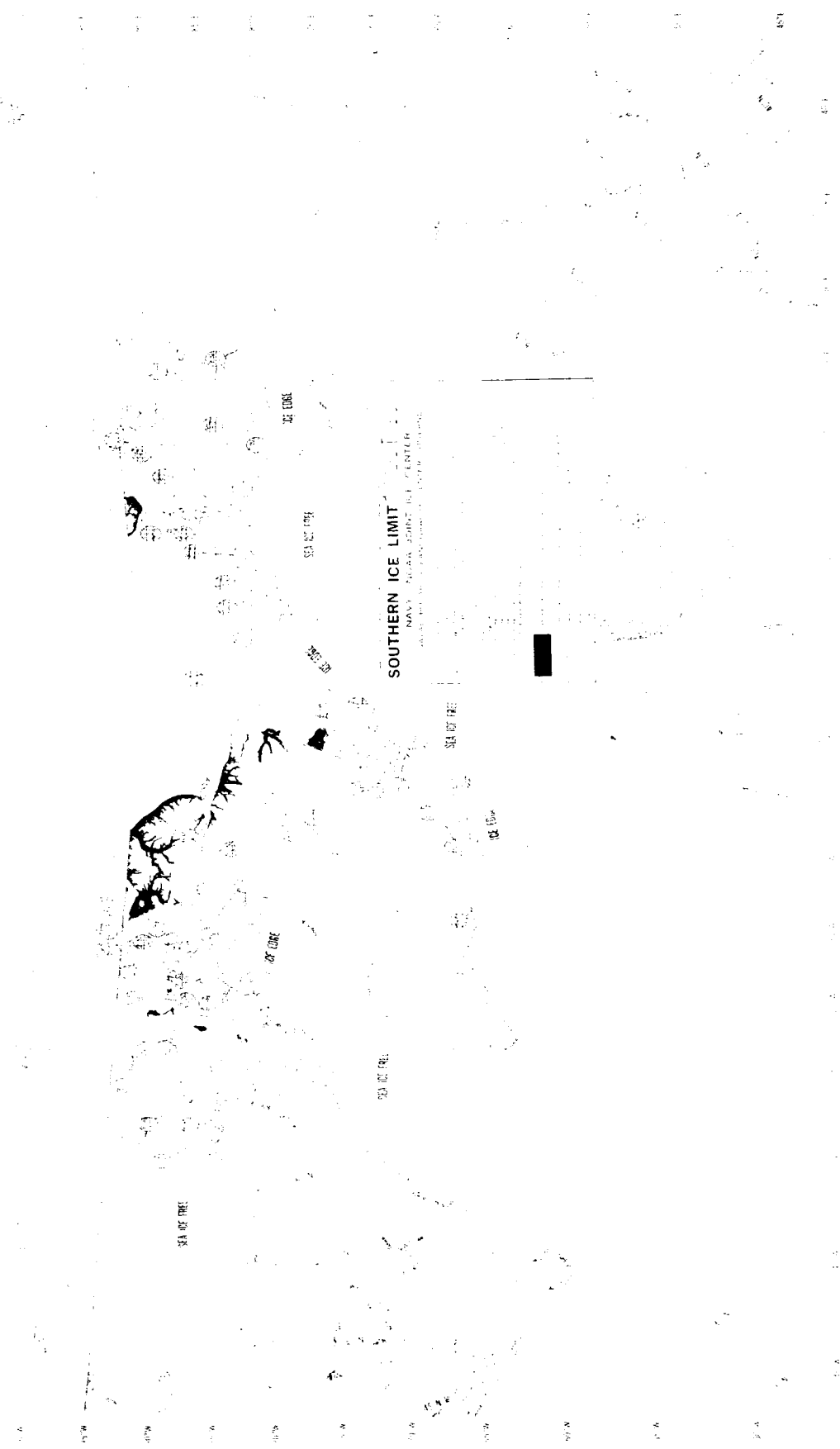
SEA ICE FREE

ICE FREE

SEA ICE FREE

ICE FREE

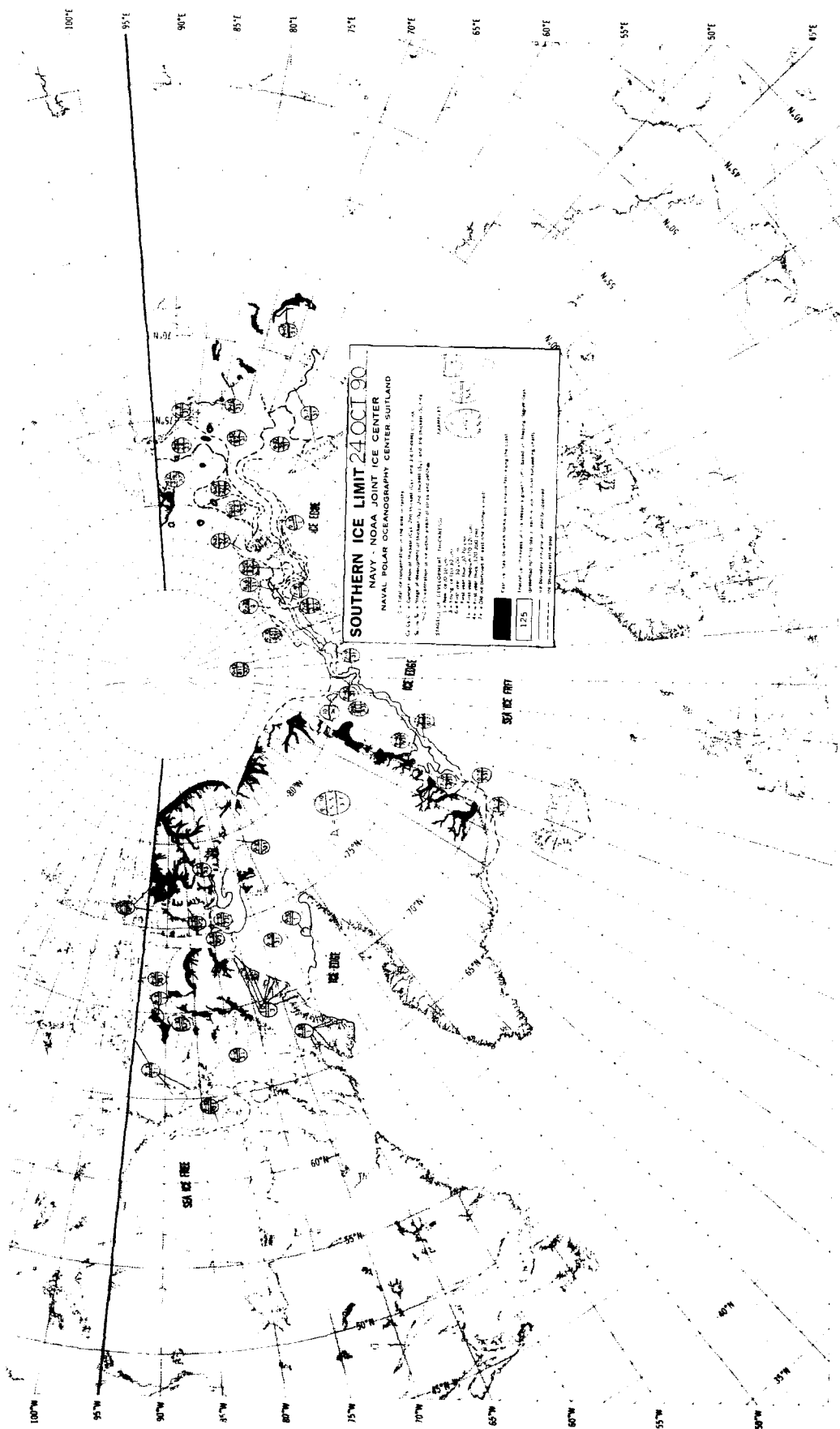
SEA ICE FREE

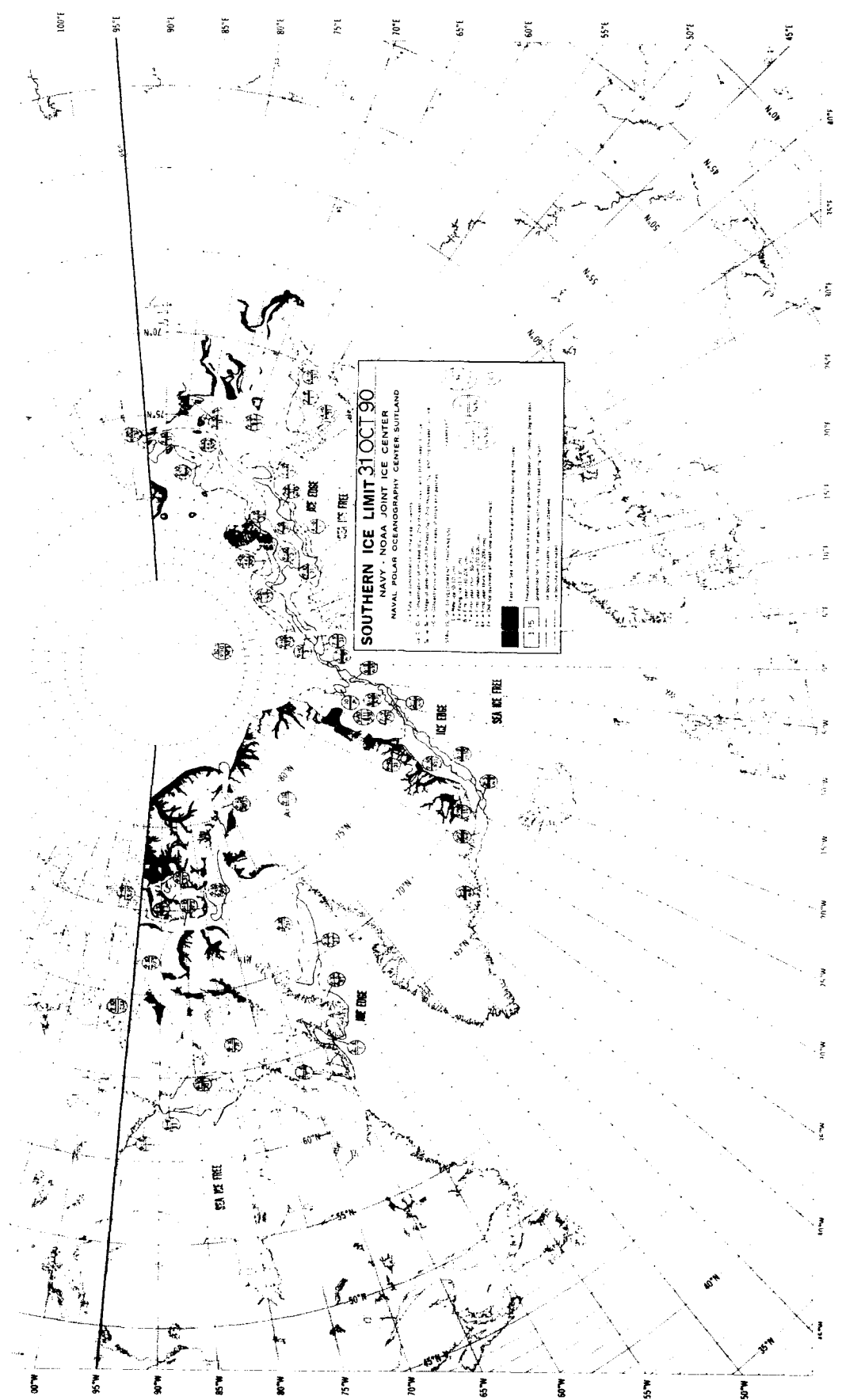


SOUTHERN ICE LIMIT

NAVY NAVAL JOINT ICE CENTER

BASED ON THE 1958-1959 SEASON DATA





SOUTHERN ICE LIMIT 31 OCT 90
NAVY - NOAA JOINT ICE CENTER
NAVAL POLAR OCEANOGRAPHY CENTER SUTLAND

1. This map shows the ice limit as of 0000 UTC on 31 OCT 90. The ice limit is defined as the outer edge of the ice field. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line.

2. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line.

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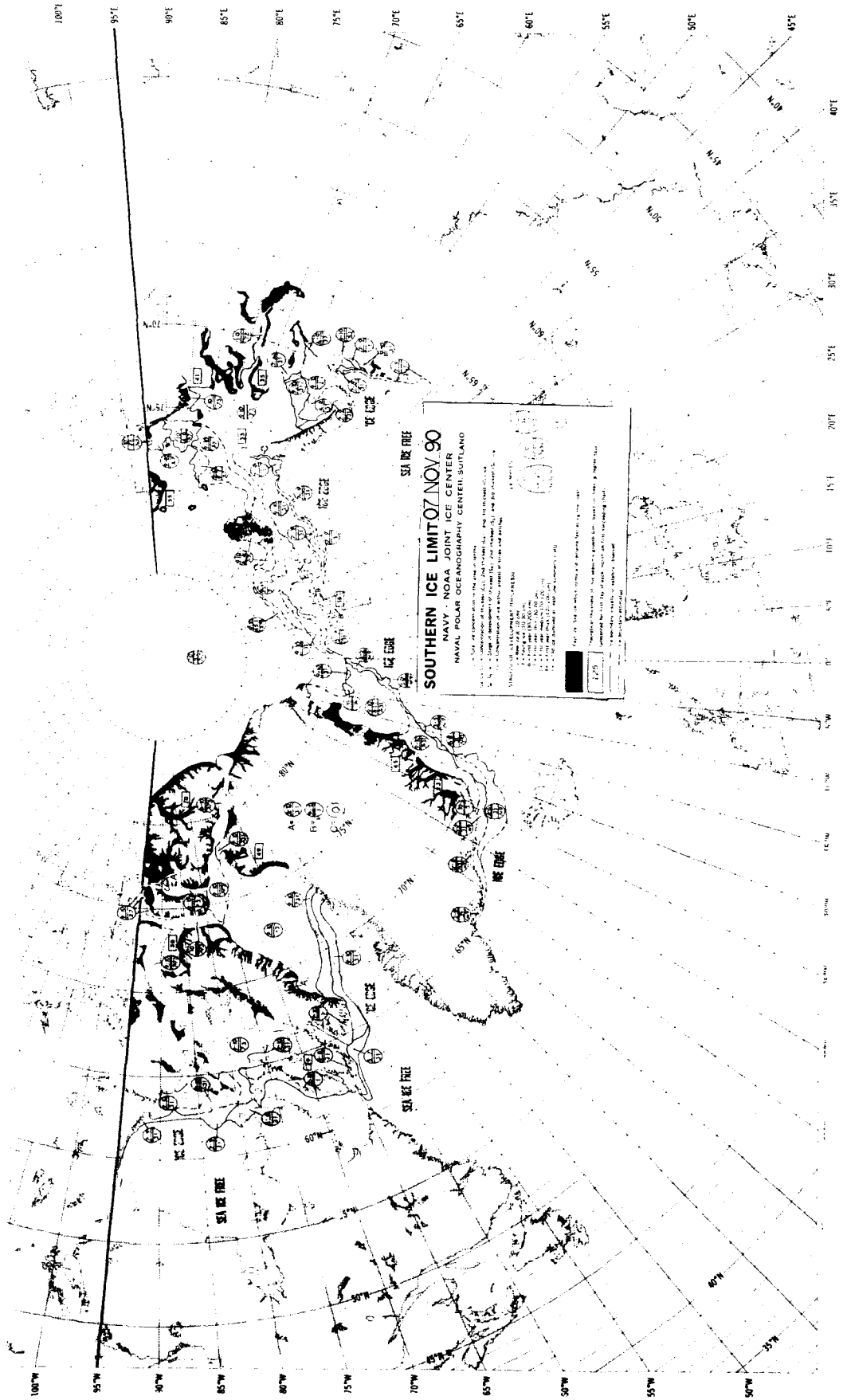
6. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line.

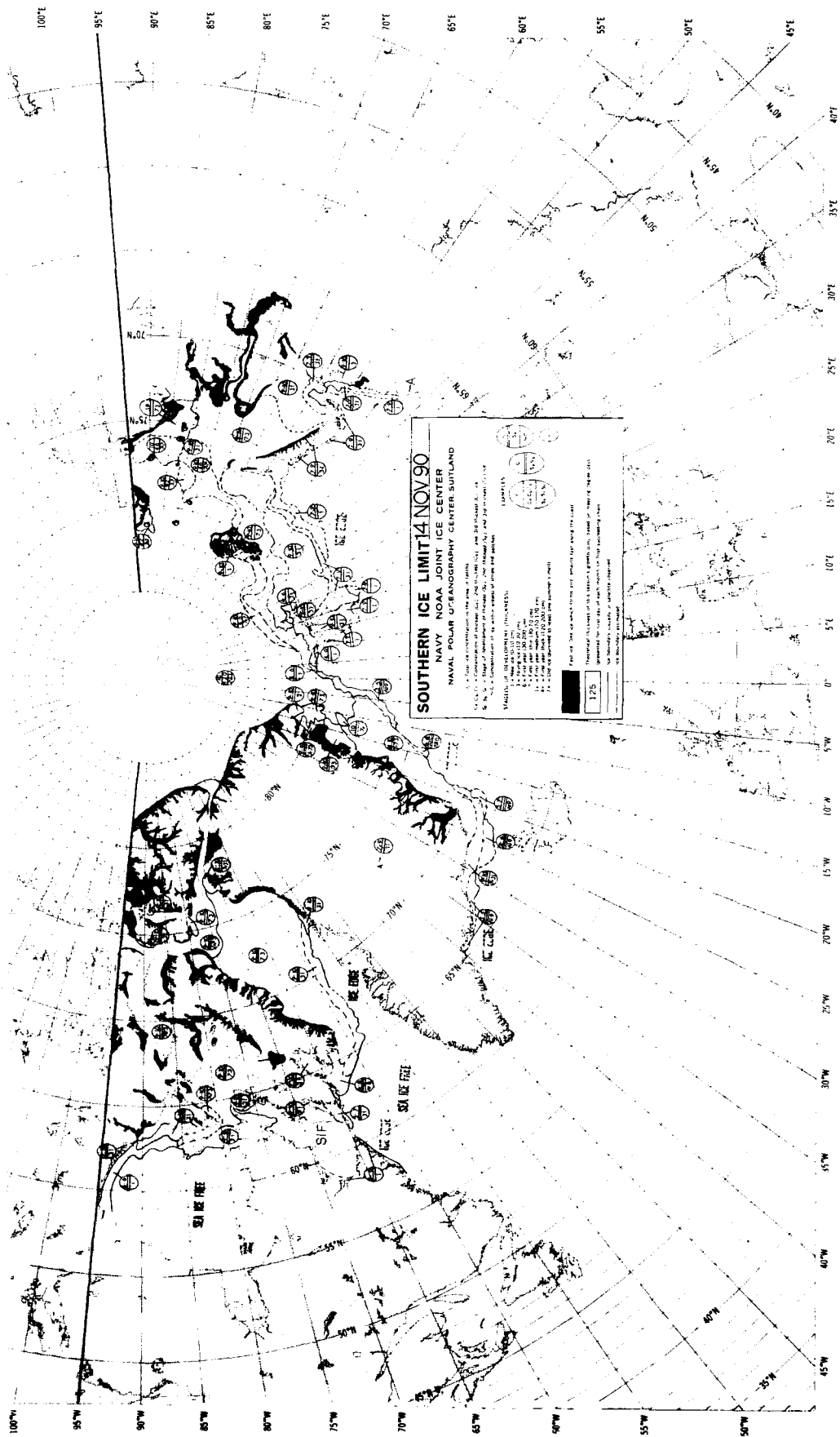
7. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line.

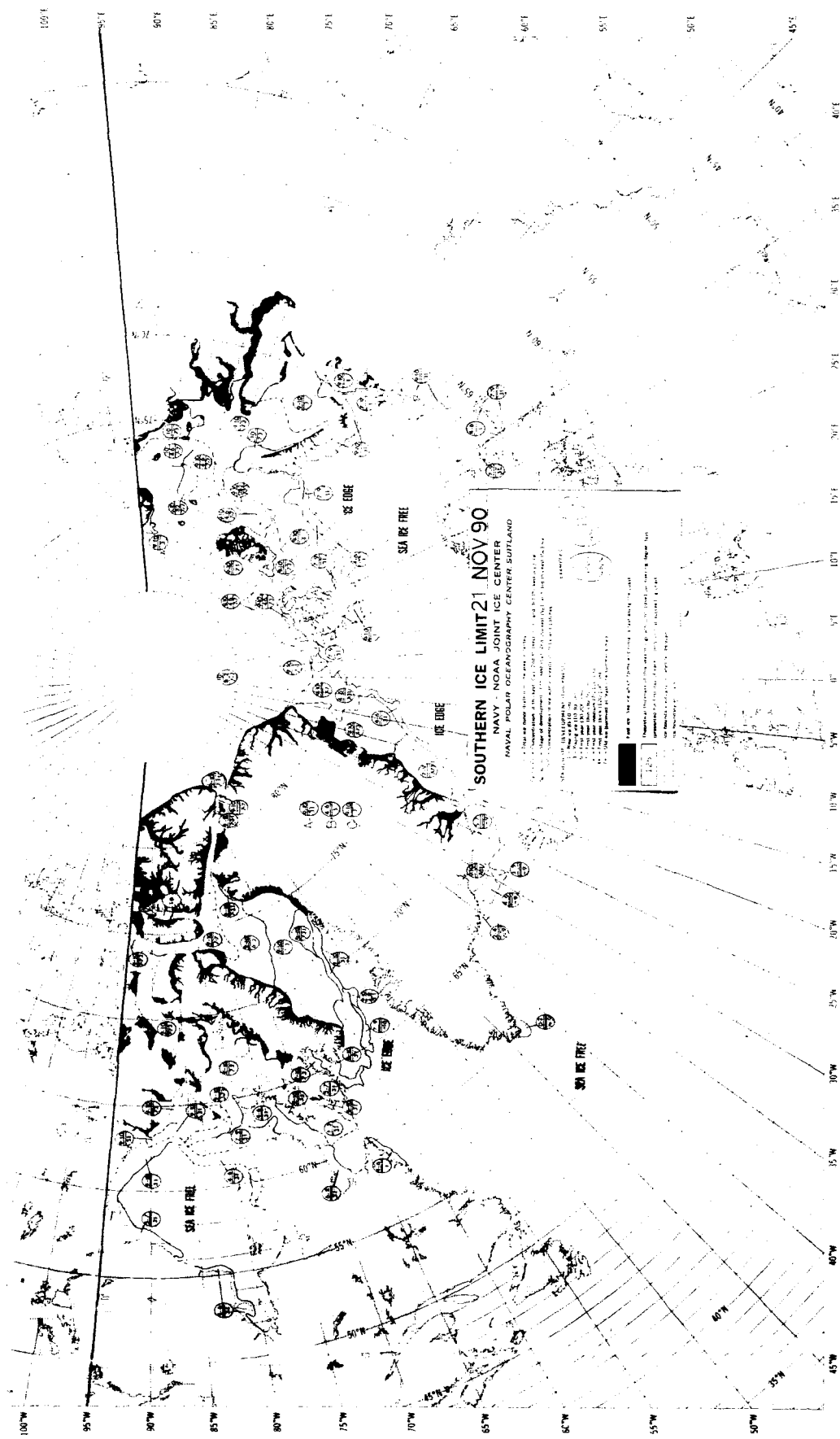
8. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line.

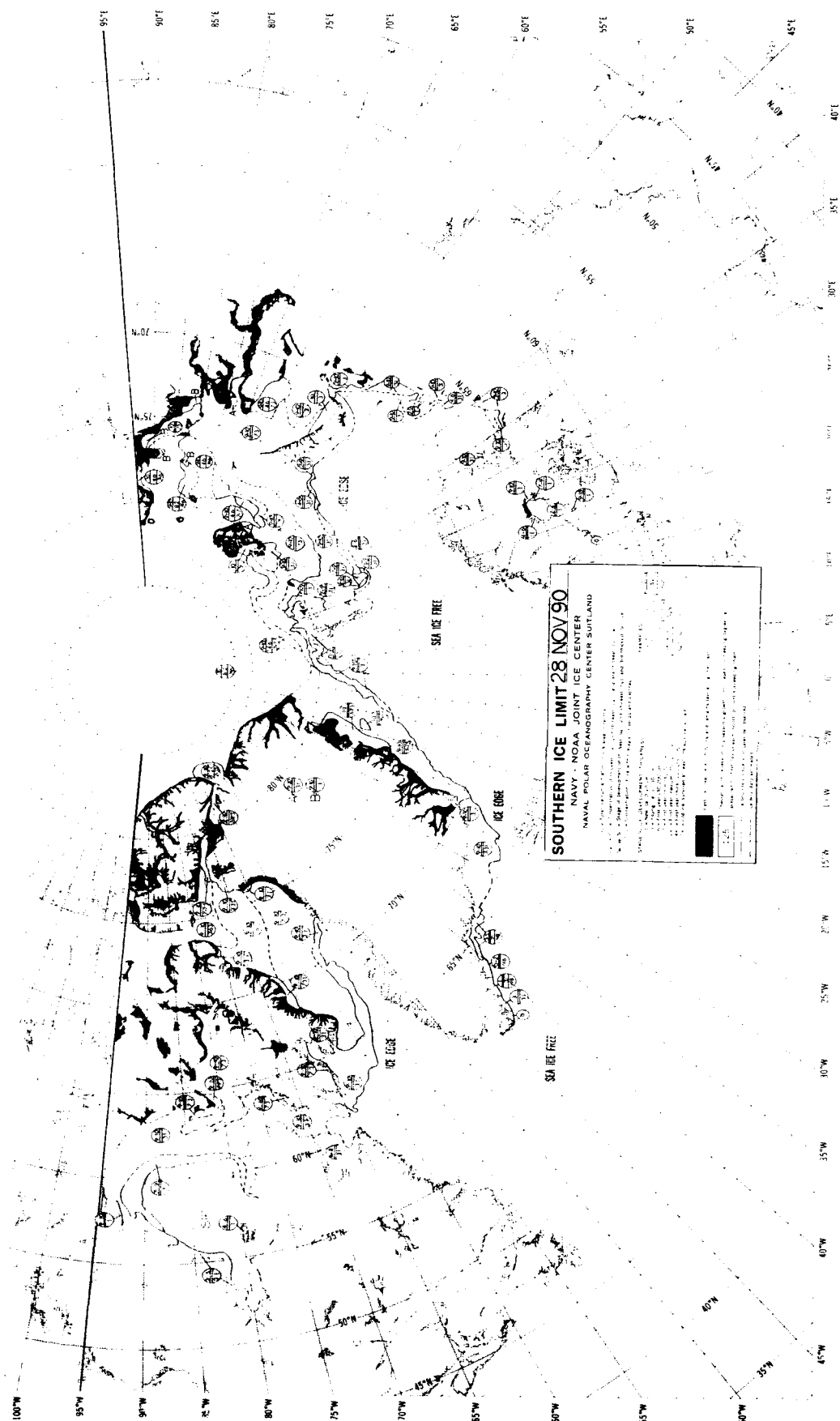
9. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line.

10. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line. The ice limit is shown as a solid line.











SOUTHERN ICE LIMIT 05 DEC 90
 NAVY - NOAA JOINT ICE CENTER
 NAVAL POLAR OCEANOGRAPHY CENTER SUTLAND

1. This map is a representation of the ice limit in the Southern Ocean as of 05 DEC 90. It is based on data from the Navy's Joint Ice Center and the NOAA's Polar Oceanography Center. The map shows the ice limit as of 05 DEC 90, and it is not intended to be used for navigation or other purposes.

2. The map is a representation of the ice limit in the Southern Ocean as of 05 DEC 90. It is based on data from the Navy's Joint Ice Center and the NOAA's Polar Oceanography Center. The map shows the ice limit as of 05 DEC 90, and it is not intended to be used for navigation or other purposes.

3. The map is a representation of the ice limit in the Southern Ocean as of 05 DEC 90. It is based on data from the Navy's Joint Ice Center and the NOAA's Polar Oceanography Center. The map shows the ice limit as of 05 DEC 90, and it is not intended to be used for navigation or other purposes.

4. The map is a representation of the ice limit in the Southern Ocean as of 05 DEC 90. It is based on data from the Navy's Joint Ice Center and the NOAA's Polar Oceanography Center. The map shows the ice limit as of 05 DEC 90, and it is not intended to be used for navigation or other purposes.

5. The map is a representation of the ice limit in the Southern Ocean as of 05 DEC 90. It is based on data from the Navy's Joint Ice Center and the NOAA's Polar Oceanography Center. The map shows the ice limit as of 05 DEC 90, and it is not intended to be used for navigation or other purposes.

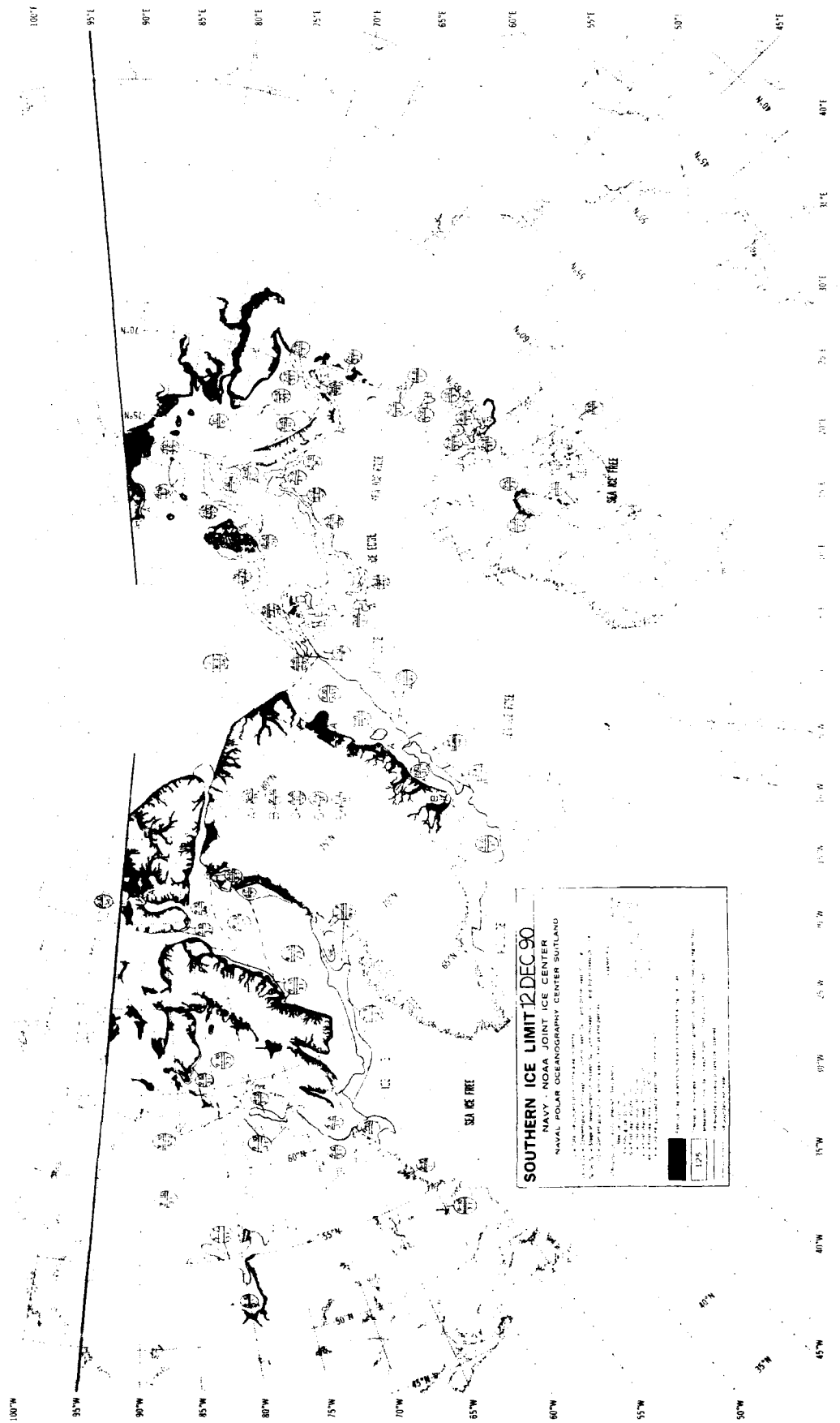
6. The map is a representation of the ice limit in the Southern Ocean as of 05 DEC 90. It is based on data from the Navy's Joint Ice Center and the NOAA's Polar Oceanography Center. The map shows the ice limit as of 05 DEC 90, and it is not intended to be used for navigation or other purposes.

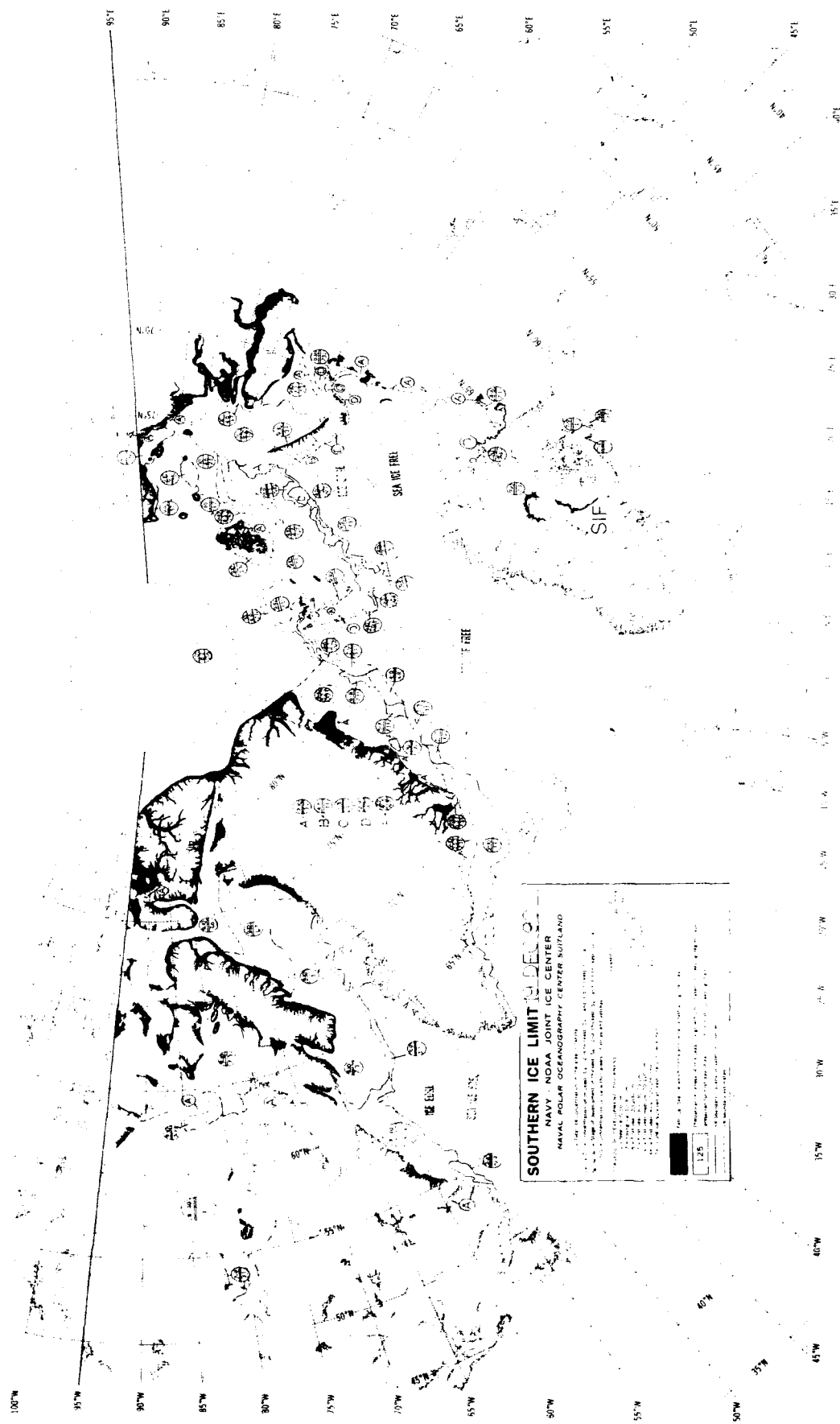
7. The map is a representation of the ice limit in the Southern Ocean as of 05 DEC 90. It is based on data from the Navy's Joint Ice Center and the NOAA's Polar Oceanography Center. The map shows the ice limit as of 05 DEC 90, and it is not intended to be used for navigation or other purposes.

8. The map is a representation of the ice limit in the Southern Ocean as of 05 DEC 90. It is based on data from the Navy's Joint Ice Center and the NOAA's Polar Oceanography Center. The map shows the ice limit as of 05 DEC 90, and it is not intended to be used for navigation or other purposes.

9. The map is a representation of the ice limit in the Southern Ocean as of 05 DEC 90. It is based on data from the Navy's Joint Ice Center and the NOAA's Polar Oceanography Center. The map shows the ice limit as of 05 DEC 90, and it is not intended to be used for navigation or other purposes.

10. The map is a representation of the ice limit in the Southern Ocean as of 05 DEC 90. It is based on data from the Navy's Joint Ice Center and the NOAA's Polar Oceanography Center. The map shows the ice limit as of 05 DEC 90, and it is not intended to be used for navigation or other purposes.





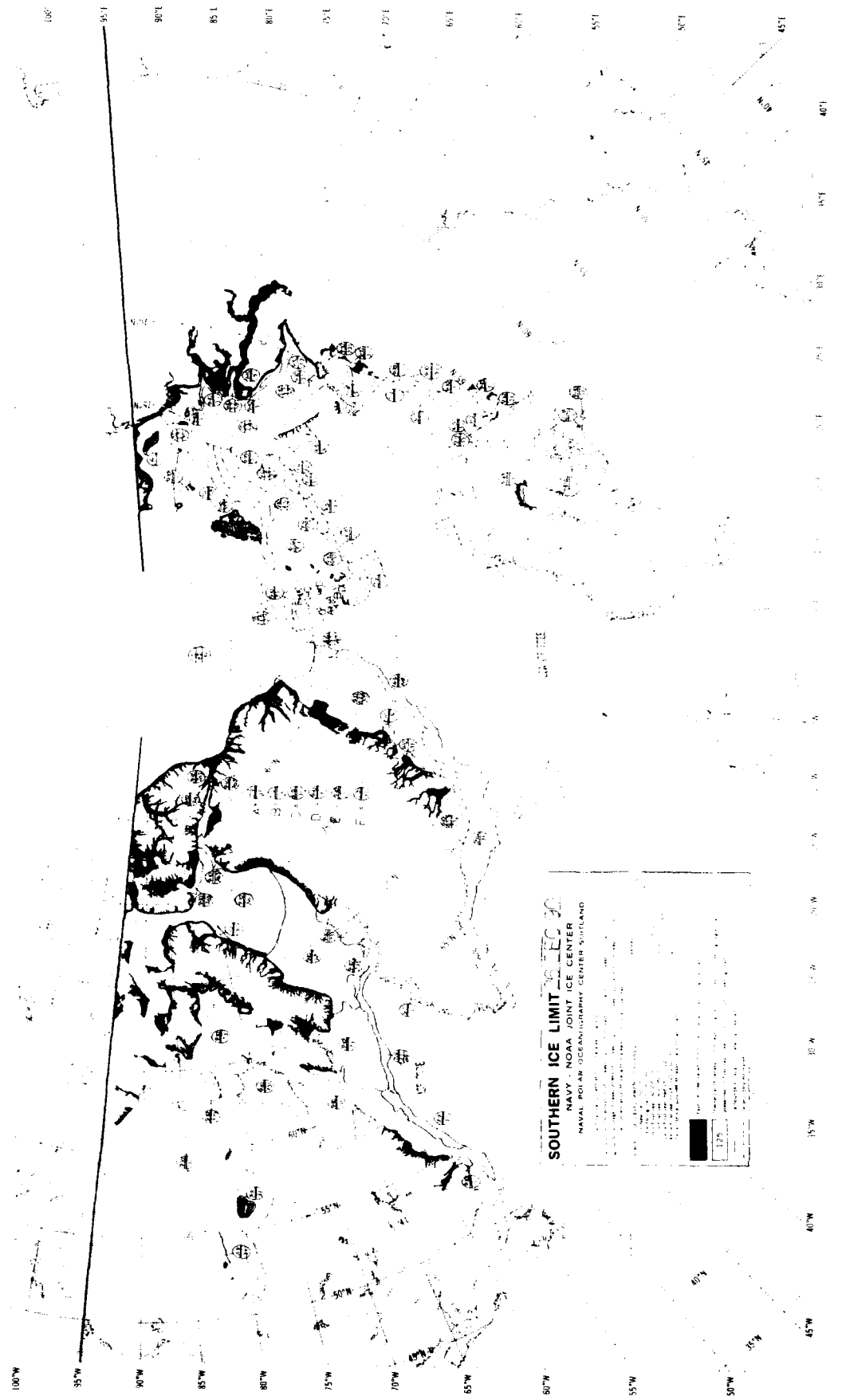


TABLE 1. SATELLITE DATA UTILIZED DURING 1990 (ARCTIC)

| Time period | | Satellite Remote Sensing | | | | |
|-------------|-------|--------------------------|-------------|------------------------|------------|----------|
| From | To | Sensor Platform | Sensor Type | Spectral Region | Resolution | Coverage |
| 1-90 | 12-90 | NOAA-10 | AVHRR | | | |
| | | | HRPT/LAC | | | |
| | | | VIS | 0.58-0.68 um | 1 km | Regional |
| | | | NIR | 0.725-1.10 um | | |
| | | | IR | 10.5-11.5 um | | |
| | | NOAA-11 | GAC | | | |
| | | | VIS | 0.58-0.68 um | 4 km | Global |
| | | | IR | 10.5-11.5 um | | |
| 1-90 | 12-90 | NOAA-11 | AVHRR | | | |
| | | | HRPT/LAC | | | |
| | | | VIS | 0.58-0.68 um | 1 km | Regional |
| | | | NIR | 0.725-1.10 um | | |
| | | | IR | 10.5-11.5 um | | |
| | | DMSP-F(8) | GAC | | | |
| | | | VIS | 0.58-0.68 um | 4 km | Regional |
| | | | IR | 10.5-11.5 um | | |
| 1-90 | 12-90 | DMSP-F(8) | OLS | | | |
| | | | VIS | 0.4-1.1 um | .62 km | Regional |
| | | | IR | 10.2-12.8 um | .62 km | Regional |
| | | | SSM/I | | | |
| | | | MW | 1.55 cm (19.35 GHz) | 50 km | Global |
| | | | | 0.81 cm (37.0 GHz) | 35 km | Global |

Abbreviations and Acronyms

AVHRR - Advanced Very High Resolution Radiometer
 cm - Centimeter
 GAC - Global Area Coverage
 GHz - Giga-hertz
 HRPT - High Resolution Picture Transmission
 IR - Infrared
 km - Kilometer
 LAC - Local Area Coverage
 MW - Microwave
 NIR - Near Infrared
 OLS - Operational Line Scan System
 SSM/I - Special Sensor Microwave Imager
 um - Micrometer
 VIS - Visible

**EASTERN—WESTERN
ARCTIC SEA ICE ANALYSIS
1990**

